TECHNISCHE UNIVERSITÄT DRESDEN

Faculty of Environmental Sciences

Homeowners and disaster insurance – insights from Ghana

Doctoral dissertation

submitted on 20 January, 2017

for obtaining the degree of Doctor rerum naturalium (Dr. rer. nat.)

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In memory of Kwabena Boadu.

Acknowledgment

The research would not have been possible without financial support (by way of scholarship) from the Dresden Leibniz Graduate School (DLGS), Dresden, Germany.

Many individuals also contributed to the successful completion of this dissertation in a variety of ways. I would like to take this opportunity to thank them.

First, I am grateful to Prof. Dr. Dr. Bernhard Müller, Executive Director of the Leibniz Institute of Ecological Urban and Regional Development (IOER), Dresden, and Chair for Spatial Development, Faculty of Environmental Sciences at the Technische Universität Dresden, Germany. I appreciate his interest and readiness to supervise my work.

My deepest gratitude also goes Prof. Dr. Marcel Thum of the Chair of Public Economics, Faculty of Business and Economics at the Technische Universität Dresden and Director of ifo Institute for Economic Research, Dresden. Prof. Thum was always on hand to give prompt and constructive feedback which improved the dissertation.

I thank Dr. Gerard Hutter of the IOER for suggestions that shaped the theoretical dimension of the research. I am also grateful to management and staff of IOER as well as the DLGS, especially Dr. Paulina Schiaccapasse and Dr. Sabine Scharfe for their immense support.

My colleagues at the DLGS also deserve special thank you; despite our diverse national and academic backgrounds, we lived and worked together as a family.

I also thank the anonymous reviewers and editors of the journals that published the individual articles in the dissertation for their helpful comments and readiness to publish the articles.

Last and most importantly, I thank my family and friends, especially my dear wife, Nana Adutwumwaa, for all the sacrifices.

Abstract

Floods, earthquakes, storms and other natural disasters wreak havoc across the globe each year. Climate change threatens to aggravate the problem. Insurance can be one way to make societies more resilient these disasters; by spreading risks over time and space, insurance softens the blows of natural disasters, helps victims to recover quickly, and incentivises risk reduction. In many developing countries, however, many homeowners lack the security insurance provides; instead, they depend on disaster aid in the event of a catastrophe, which is often unreliable. To improve access to (disaster) insurance in developing countries, global political leaders have initiated several programmes, such as the G7 *InsuResilience* Initiative. Evidence, however, shows that even where disaster insurance is widely accessible, only a few individuals purchase it, implying that the low adoption of disaster insurance in developing countries goes beyond accessibility. Understanding the causes of the low demand for the existing insurance schemes would inform the design of future ones.

This thesis, therefore, examines why homeowners in Ghana fail to purchase disaster insurance for their homes despite the availability of disaster insurance for residential homes since the 1960s. What explanations does the literature provide for the lack of disaster insurance adoption? How does the lack of comprehensive data on natural hazards affect Ghanaian insurers' natural disaster insurance underwriting decisions? Are individuals who believe that luck, chance, fate, or powerful others determine what happens to them less likely to purchase natural disaster insurance, compared with those who believe that they can influence what happens to them? The thesis addresses these questions in three peer-reviewed articles, specifying how the decisions of insurers, individuals and governments affect disaster insurance adoption in Ghana.

The thesis contributes to the literature by first systematically surveying the economics, insurance and psychology literature to understand the alternative economic and behavioural

explanations for the lack of demand for disaster insurance, especially in developing countries. The thesis also shows that contrary to standard insurance theory, Ghanaian insurers do not reward investments in preventive measures with lower premia and rather charge higher premia since they lack information about risks at the micro level and therefore interpret risk reduction measures as a sign of high risk. The third significant contribution of the thesis is that individuals' worldviews influence their disaster insurance purchasing decisions. Based on Ghanaian survey data, the thesis finds individuals who believe they control their own destiny more likely to purchase disaster insurance, compared with those who believe that external forces, luck or fate determines life events.

Zusammenfassung

Überschwemmungen, Erdbeben, Stürme oder andere Naturkatastrophen richten rund um den Globus jedes Jahr verheerende Schäden an. Der Klimawandel droht, die Probleme noch zu verschärfen. Versicherungen können ein Weg sein, um Gesellschaften widerstandsfähiger gegen Naturkatastrophen zu machen. Versicherungen lindern die Auswirkung von Naturkatastrophen, indem sie die Risiken über Zeit und Raum verteilen. Sie helfen Betroffenen, um wirtschaftlich wieder auf die Beine zu kommen, und bieten Anreize zum Abbau von Risiken. Trotzdem schließen die meisten Hausbesitzer in Entwicklungsländern kaum Versicherungen ab. Stattdessen sind sie im Katastrophenfall abhängig von Beihilfen, welche jedoch oft nur unzuverlässig fließen. Um den Zugang zu Versicherungen gegen Katastrophen in Entwicklungsländern zu erleichtern, wurden weltweit verschiedene Programme aufgelegt, so etwa die G7-Initiative InsuResilience. Gerade in Entwicklungsländern versichern sich trotz verbesserter Zugänglichkeit nur wenige Menschen gegen Katastrophen. Damit scheint die unzureichende Versicherung gegen Katastrophen in Entwicklungsländern nicht allein eine Frage der Zugänglichkeit zu sein. Die Gründe für die geringe Nachfrage nach existierenden Versicherungen zu verstehen, könnte helfen, das Design neuer, effektiverer Versicherungsangebote zu beeinflussen.

Aus diesem Grund untersucht die Arbeit, warum sich Hausbesitzer in Ghana kaum gegen Katastrophen versichern, obwohl es entsprechende Angebote seit den 1960er Jahren gibt. Welche Erklärungen bietet die Literatur für die mangelnde Annahme entsprechender Versicherungen? Wie werden Ghanaische Versicherungsnehmer in ihrer Entscheidung über den Versicherungsabschluss vom Fehlen umfangreicher Daten über die Auswirkungen von Naturkatastrophen beeinflusst? Sind Menschen, die an persönliches Glück, an Chancen, an Schicksal oder an äußere, lebensbeeinflussende Mächte glauben, weniger geneigt, sich gegen Katastrophen zu versichern als Menschen, die glauben, sie könnten ihr Leben selbst

beeinflussen? Die Dissertation setzt sich in drei Artikeln mit diesen Fragen auseinander und geht darauf ein, was in Ghana die Akzeptanz von Versicherungen gegen Katastrophen beeinflusst.

Ein Beitrag der Arbeit besteht in der systematischen Aufbereitung der wirtschaftswissenschaftlichen, versicherungswissenschaftlichen und psychologischen Literatur, um – speziell in Bezug auf Entwicklungsländer – alternative wirtschafts- und verhaltenswissenschaftliche Erklärungsansätze für das Fehlen einer Nachfrage nach Versicherungen gegen Katastrophen zu verstehen. Die Arbeit zeigt außerdem, dass Ghanaische Versicherungen – im Gegensatz zur gängigen Versicherungstheorie – Investitionen der Versicherungsnehmer in Präventionsmaßnahmen nicht durch niedrigere Prämien honorieren. Weil den Versicherungen Informationen über Risiken auf Mikroebene fehlen, interpretieren sie solche Maßnahmen als Zeichen für ein erhöhtes Risiko und verlangen sogar höhere Prämien. Ein dritter Beitrag der Arbeit untersucht – anhand von Ghanaischen Befragungsdaten – die Hypothese, dass die fundamentale Weltanschauungen die Entscheidung über den Abschluss einer Versicherung gegen Katastrophen beeinflusst werden. Menschen, die glauben, sie könnten ihr Schicksal selbst bestimmen, versichern sich eher gegen Katastrophen als Menschen die glauben, ihr Leben würde durch äußere Mächte, Glück oder das Schicksal bestimmt.

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Abbreviations and acronyms

A2ii	Access to Insurance Initiative
ABI	Association of British Insurers
AMA	Accra Metropolitan Assembly
AOSIS	Alliance of Small Island States
ARC	African Risk Capacity
CCR	Caisse Centrale de Rèassurance (*Central Reinsurance Agency*)
CCRIF SPC	The Caribbean Catastrophe Risk Insurance Facility
COP	Conference of Parties
CRED	Centre for Research on the Epidemiology of Disasters
CRII	Climate Risk Insurance Initiative
EM-DAT	Emergency Events Database
FEMA	Federal Emergency Management Agency
G7	Group of 7 Nations
GDV	Gesamtverband der Deutschen Versicherungswirtschaft (*German Insurance Association*)
ICI	Internal Control Index
IDNDR	International Decade of Natural Disaster Reduction
IOER	Leibniz Institute of Ecological Urban and Regional Development
IPCC	Intergovernmental Panel on Climate Change
MCII	Munich Climate Insurance Initiative
NFIP	National Flood Insurance Program
PCRAFI	The Pacific Catastrophe Risk Assessment and Financing Initiative
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations International Strategy for Disaster Reduction

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Chapter 1 Introduction and background

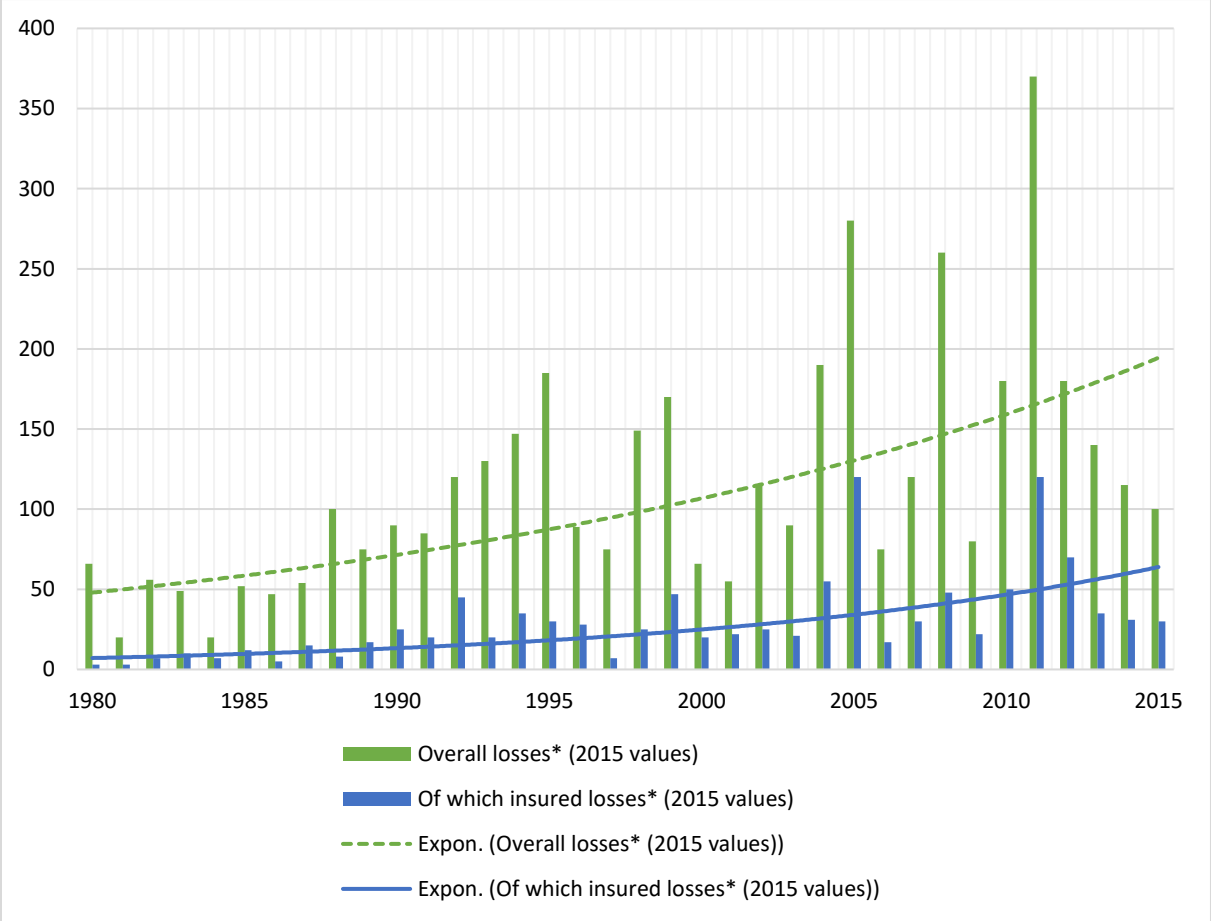
Floods, earthquakes, storms, tornadoes, hurricanes, landslides and other extreme natural events wreak havoc, personal suffering and huge economic losses each year. In 2015, for example, Munich Re (2016) identified a record number of 1,060 major natural catastrophes around the world, claiming 23,000 lives and accounting for US$100bn direct economic costs, of which US$30bn was insured. As Figure 1.1 shows, the direct economic costs of natural disasters have seen an upward trend in recent decades with the inflation-adjusted direct economic costs of these catastrophic events averaging US$180bn a year in the last decade (Munich Re, 2016). A recent World Bank study, however, suggests that the human and economic costs of natural disasters have been underestimated by 60%, once the impact on poor people is considered. The study of 117 countries estimates the cost of natural disasters to be US$520bn a year, forcing about 26 million people into poverty yearly (Hallegatte et al., 2017).

Relative to their economic strength, low- and middle-income countries tend to bear the brunt of natural catastrophes as they suffer more direct economic losses and account for more fatalities. As an example, in 2010, two earthquakes struck the island states of Haiti and New Zealand. Von Peter, Von Dahlen and Saxena (2012) report that although the two events had an identical magnitude of 7.0, they commanded radically different consequences; whereas there were no fatalities in New Zealand, the event in Haiti claimed about 220,000 lives. They report further that New Zealand suffered direct economic cost of US$6.5bn, which was *only* 5.3% of her 2010 gross domestic product, compared with Haiti's cost of US$8bn, which constituted 126% of her 2010 gross domestic product.

Those who have examined the causes of the increasing economic cost of natural disasters agree that it is too early to attribute the rising cost of natural disasters to climate change and that the increasing exposure of vulnerable people and assets to natural hazards is the foremost reason (Changnon, 2003; Crompton & McAneney, 2008; Bouwer, 2011; Simmons, Sutter & Pielke,

2012; IPCC, 2012). This being the case, it stands to reason that addressing society's vulnerability and exposure to natural hazards now will benefit society today and at the same time lessen the frequency and impact of natural disasters under any future climate.

Figure 1.1: Overall and insured losses 1980 to 2015 (in US$ bn)



**Values adjusted for inflation using the Consumer Price Index (CPI) of each country and taking into account fluctuations in exchange rates.*

Source: Adapted from Munich Re (2016)

To reduce disaster risks, it is important to understand its components. Crichton (1999; 2008) conceives of natural disaster risk as the product of natural hazards, exposure and vulnerability (Figure 1.2). Hazard is the extreme natural physical event whose occurrence may adversely affect exposed and vulnerable people and assets. Exposure, on the other hand, is when persons or assets are in potentially dangerous areas. Although exposure is a necessary determinant of risk, it is not sufficient; one may be exposed, but not vulnerable. For example, even though

most Japanese cities are exposed to earthquake risks, Japanese buildings are often able to withstand earthquakes because of the country's stringent building regulations (Bilham, 2009). Vulnerability refers to the propensity of exposed people or assets to suffer adverse effects when impacted by an extreme natural event. Per this formulation, an earthquake, for instance, does not constitute a disaster unless vulnerable people or assets are exposed to it. Crichton's (1999; 2008) view on natural disasters, though, is not new. In 1756, while discussing the 1755 Lisbon earthquake with Voltaire, Rousseau argued that natural disasters occur when vulnerable people or property are exposed to natural hazards. In his view, there must be earthquakes unless 'nature must change to suit our fancies… and submit herself to our laws' (Voltaire & Wootton, 2000, p. 111). This view of natural disasters implies that although natural hazards may be beyond human control, societies can reduce disaster risk by minimising exposure (for example, through land-use planning) and vulnerability (for example, by retrofitting existing buildings to make them resilient) of people and assets to natural hazards.

Figure 1.2: The Crichton risk triangle

Source: Crichton (1999; 2008)

The idea that natural disaster risks can be reduced gained international political support when the UN launched the International Decade of Natural Disaster Reduction (IDNDR) in 1989, shifting focus from disaster assistance to disaster risk reduction and preparedness (United Nations, 1989). Most developed countries have since invested in risk reduction measures, a graphic example being the German city of Dresden. The city suffered major floods in August 2002 and July 2013 and although the magnitude and spatial extension (as measured by the flood severity index) of the 2013 floods was almost twice that of the August 2002 floods, the impact of the 2013 flood was much less as a result of the huge public investments in flood risk reduction since the 2002 floods (Merz et al., 2014).

By contrast, developing countries lack the discipline, financial resources and technical knowledge to undertake such preventive measures. Enforcing land-use planning and building codes at the local level is weak because of insufficient inspectors, corruption or inadequate training (Bilham, 2009). Consequently, individuals build on plots they do not own and without the assent of the authorities, making it difficult to control the construction of new buildings in hazard-prone areas. In addition, there are significant numbers of people already living in hazard-prone areas, pointing up the need to develop societal capacity to co-exist with natural hazards and help the recovery of those affected by disasters. Therefore, although preventive measures are preferable, the 'inconvenient truth' is that there will always be some residual risks, which require *reactive* measures to help society to recover financially after inevitable natural disasters. This thesis focuses on one reactive measure, insurance, and examines why many homeowners in developing countries fail to insure their homes, despite the increasing threat natural catastrophes pose.

1.1 Insurance as part of disaster risk management

Although insurance developed fully as a commercial concept in the eighteenth century, the idea of sharing and spreading risks dates to at least the eighteenth-century BC. The Babylonian Code

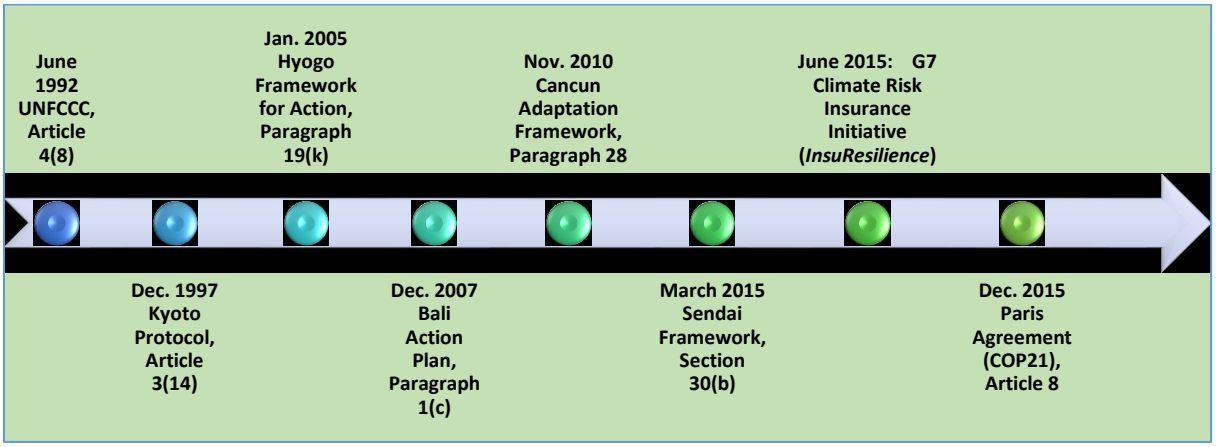
of Hammurabi devoted 282 clauses to the issue of *bottomry,* a system of merchant insurance in which a ship owner took a loan to finance a ship's voyage and if the ship sunk, the ship owner did not have to repay the loan (Bernstein, 1998). Later in the Roman era, Emperor Claudius (10 BC-AD 54), in his quest to boost grain trade, took personal responsibility for storm losses suffered by Roman merchants (Bernstein, 1998). The first modern insurance contract is believed to have been issued in Genoa, Italy, in 1343 for marine cargo (Nelli, 1972) and following the Great Fire of London in 1666, the first fire insurance policies were introduced in England (Freeman & Kunreuther, 2003).

Given the historical role risk sharing has played in managing disasters[1], it is not surprising that scholars highlight insurance as a policy tool that can provide timely financial relief to aid the financial recovery of victims of disasters (Warner et al., 2012; Cimato & Mullan, 2010). In simple terms, insurance allows individuals to transfer their risks to an insurance company by paying a fee (premium), with the company agreeing to reimburse part or all losses that the individuals may incur should a specified event occur. Individuals prefer to pay a small, fixed amount to transfer the risk of suffering a potentially larger loss to the insurance company because of risk aversion; even if the adverse event insured against does not happen, insurance can provide peace of mind to the insured. By pooling the risks of many individuals, insurance allows the financial impact of an adverse event that could be disastrous for an individual to be spread over time and space, thus 'softening the blow' of disasters and quickening the financial recovery of victims. Studies show that all things being equal, countries with higher insurance

[1] Indeed, during the negotiations of the United Nations Framework Convention on Climate Change (UNFCCC), Vanuatu proposed, on behalf of the Alliance of Small Island States (AOSIS), the formation of an International Insurance Pool. They proposed the creation of a fund to compensate small-island and low-lying developing countries who suffer losses resulting from sea-level rise (Intergovernmental Negotiating Committee, 1991). Although the proposal was rejected, Article 4(8) of the UNFCCC captured the idea of using insurance as a form of climate change adaption (United Nations, 1992).

penetration are better able to bear natural disasters than those with lower insurance penetration (Melecky & Raddatz, 2011; Von Peter, Von Dahlen & Saxena, 2012).

Figure 1.3: Milestones on insurance for adaptation



At the international level, political leaders view insurance as a policy tool that can form part of an overall disaster risk management strategy to enhance the resilience of societies to natural disasters. As Figure 1.3 highlights, there have been some of the key milestones in international recognition of insurance as a tool to enhance the resilience of cities to natural catastrophes. Perhaps the clearest political support for insurance came in 2015. In March 2015, the UN World Conference in Sendai adopted the Sendai Framework for Disaster Risk Reduction 2015–2030, of which Section 30(b) advocates for insurance-related solutions (UNISDR, 2015). Then in June 2015, the leaders of Canada, France, Germany, Italy, Japan, the UK and the US (the G7) adopted the Climate Risk Insurance Initiative (CRII) at a G7 summit in Elmau (Germany), aiming to increase access to insurance coverage against natural disasters for up to 400 million of the most vulnerable people in developing countries by 2020 (G7, 2015). Dubbed *InsuResilience*, the initiative aims, among others, to provide funds to increase the risk bearing capacity of insurance markets in developing countries. Then in December 2015, at the UN Climate Change Conference in Paris (COP 21), parties to the UNFCCC agreed to strengthen

the global response to climate change, and Article 8 of the of the Agreement includes 'Risk Insurance facilities, climate risk pooling and other insurance solutions' (UNFCCC, 2015).[2]

These initiatives are positive developments because not only do poor and rich countries differ in the extent to which natural disasters affect them but also the extent to which they recover their losses through insurance. Returning to the earlier example of the 2010 earthquakes in Haiti and New Zealand, whereas New Zealand recovered 81% of the direct losses through insurance, the amount recovered from insurance was less than 1% in Haiti (Von Peter, Von Dahlen & Saxena, 2012). In general, about 40% of disaster losses in the developed world are recovered through private insurance (Warner et al., 2012). In addition, there are various government-sponsored disaster insurance schemes, which is discussed in the next section.

1.2 Role of markets and government in disaster insurance

Beyond the recovery role insurance plays, another key advantage insurance brings to risk management is its ability to help reduce disaster risks to society through risk aggregation, risk segregation and controlling behaviour (Priest, 1996). This section briefly discusses how private markets and government-sponsored insurance pools play these roles.

First, pooling large numbers of risks that are statistically independent allows insurance to reduce risk to society; for these statistically independent risks, aggregation reduces the variance. In other words, for statistically independent risks, the sum of the aggregated risks is less than the sum of the individual risks (Priest, 1996). The reduction is derived from the operation of the law of large numbers: increasing the number of insureds will decrease the variance between the

[2] Prior to these, Article 4(8) of the UNFCCC (United Nations, 1992), Article 3(14) of the Kyoto Protocol (UNFCCC, 1997), Paragraph 19(k) of the Hyogo Framework for Action (UNISDR, 2005), Paragraph 1(c) of the Bali Action Plan (UNFCCC, 2008), as well as Paragraph 28 of the Cancun Adaptation Framework (UNFCCC, 2011) mention insurance-related solutions to make societies more resilient to natural disasters.

expected outcome and the true outcome. With natural disasters, however, this benefit can be lost since local losses are correlated (that is, one event affects many individuals). Usually, insurance companies mitigate this challenge by buying international reinsurance contracts to spread the risk over large geographical areas. They may also bundle together several types of risks. For example, anyone who purchases fire insurance is automatically covered against floods, earthquake and storms; to the extent that these risks are not correlated, bundling them reduces the accumulated risk of any specific risk event (Worthington, 2015).

The second way insurance reduces risk levels is through risk segregation (risk classification). Risk classification allows insurers to distinguish between high-risk and low-risk individuals, and then charge premiums reflecting the predicted cost of compensating a policyholder for their loss. Insurers classify policyholders based on certain identifiable features which correlate with the adverse event being insured against. For example, with respect to flood insurance, a property located near a river will be viewed as riskier than the one located on a hill. Those living in relatively safe areas would thus pay premiums reflecting their low risk profile while those living in risky areas pay correspondingly high premiums. By charging premiums that reflect risk levels, insurance signals the risk of living in hazard-prone areas: a higher premium for the same level of coverage implies a greater chance of suffering a loss. Risk-reflective premiums can also incentivise policyholders to undertake preventive measures in return for a lower premium.[3]

Insurance also reduces risks by monitoring and controlling behaviour. Insurers can require that certain minimum standards (for example, building codes) are met before granting coverage.

[3] Risk classification, however, can lead to the exclusion of the poor from insurance since their vulnerability and exposure to natural hazards will translate into steep premiums (Thomas, 2007). Consequently, some governments try to restrict risk classification. Other governments directly get involved in the provision of natural disaster insurance either as insurers (for example, Spain and New Zealand) or reinsurers (for example, Japan and France). Most government-sponsored insurance pools charge uniform premium; therefore, those who live in relatively safe areas subsidise those who live in hazard-prone areas (McAneney et al., 2016).

The terms and conditions of the insurance policy can also require policyholders to undertake some specific loss prevention measures as a prerequisite for coverage. Most importantly, insurers try to control moral hazard, the tendency for individuals to become reckless after buying insurance since they do not bear the financial cost of losses. Regarding the insurance of natural disasters, Jaffee and Russel (1997) claim that moral hazard is unlikely since natural hazards are beyond the control of the insured. However, if one conceives of disasters as the interaction between natural hazards, exposure, and vulnerability, one observes that even if an insured cannot control the probability of natural perils occurring (for example, floods), they can mitigate the extent of damage by not placing valuable items in basements (that is, reduce exposure). For instance, a policyholder may place unwanted household items in the basement during floods to claim compensation. Moral hazard must be distinguished from the other perverse incentives insurance can provide, such as encouraging new constructions in risky areas. Since settling in hazard-prone areas is observable, it is not moral hazard since insurers can charge risk-adequate premiums to reflect the high risk of living there.

Private insurers control moral hazard by providing less than 100% coverage, using risk-sharing measures such as deductibles, co-insurances, upper limits and exclusions (Shavell, 1979; Priest, 1996). The deductible is the amount or percentage of loss that the insured bears before the insurer pays a claim. With co-insurance, the insured and the insurer share losses per a pre-agreed formula. The upper limit is where an insurer provides coverages worth less than the full value of the insured property (for instance, for a building worth US$100,000, the insurer may limit its liability to US$80,000). The effect of these is that the insured bears part of losses and will, therefore, be likely to take preventive measures and reduce losses. Risk-based premium also implies that those who suffer losses repeatedly might see their future premiums increase, thus incentivising them to prevent losses to avoid higher premiums. Some governments intervene in the provision of natural disaster insurance (Table 1.1), aiming to avoid what they

see as socially undesirable effects of market-led disaster insurance provision; namely, the unavailability or unaffordability of disaster insurance to certain segments of the populace. As the lower panel of Table 1.1 indicates, the loss potential under state-sponsored natural disaster insurance pools tends to be higher because governments often lack the political will to control moral hazard and the other perverse incentives that insurance coverage might provide (Priest, 1996; Worthington, 2015; McAneney et al., 2016). The US Congress, for example, created the National Flood Insurance Program (NFIP) in 1968 after private insurers withdrew flood insurance coverage following the large losses incurred during Hurricane Betsy. The NFIP has undergone series of reforms and is currently administered by the Federal Emergency Management Agency (FEMA), who produces maps of flood-prone areas. Homeowners in these areas can receive discounted premium rates if their community participates in the Community Rating System, an incentive programme that rewards investments in prescribed mitigation measures McAneney et al.(2016).

Although this has led to a high number of local authorities imposing floodplain management schemes (about 20% of the properties the NFIP insures receive discounts), Burby (2001) questions the extent to which this has restricted further construction activity in flood-hazard areas. Burby (2001) suggests that there are about 6.6 million buildings that are situated within floodplains in communities that are participants in the NFIP. More than a third of those buildings were built after the preparation of flood insurance rate maps. In addition, the NFIP is saddled with more than 24 billion in debt to the US Treasury following a series of disasters starting with Hurricane Katrina in 2005.

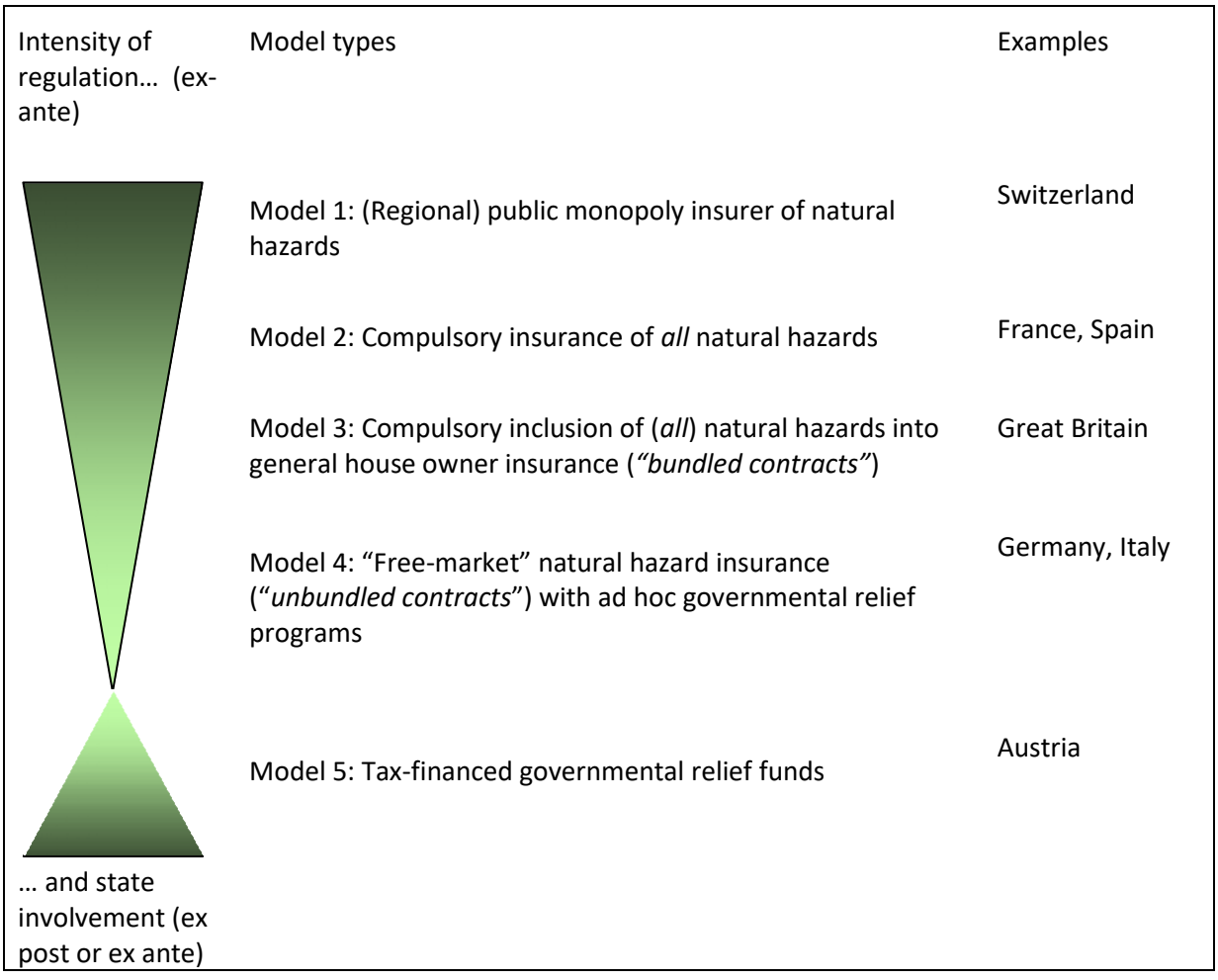
Table 1.1: Key features of some national natural disaster insurance schemes

Country	Germany	Japan	Spain	France	US	New Zealand	Turkey
Scheme	Private Market	Earthquake Reinsurance Company	Insurance Compensation Consortium	Central Reinsurance Agency	National Flood Insurance Program	Earthquake Commission	Catastrophe Insurance Pool
When established	-	1966	1954	1946	1968	1993	2000
Disasters included	Subject to insurer provision	Earthquake, tsunamis, volcanic eruptions	Floods, earthquake, seaquake, volcanic eruption, atypical cyclonic storms, and astronomic bodies	Earthquakes, floods, landslides, hailstorms, avalanches, tsunamis and droughts	Floods	Earthquakes, volcanic eruptions, hydrothermal activity, landslips and tsunamis	Earthquakes
Programme type	Private, voluntary	Public-private, voluntary	Public-private, voluntary	Public-private, compulsory	Public, semi-compulsory	Public, compulsory	Public, compulsory
Coverage	Commercial and residential	Residential only	Commercial and residential	Commercial and residential	Commercial and residential	Residential only	Residential only
Role of government	-	Reinsurer	Insurer	Reinsurer	Insurer	Insurer	Insurer
Role of private insurers	Sales, insurance and reinsurance	Sales, insurance and reinsurance	Insurance	Sales and insurance	Sales	Reinsurance	Sales
Potential for adverse selection	High	Medium	Medium	Low	Medium	Low	Low
Potential for moral hazard	Low	Low	Medium	High	High	High	High
Cost of insurance to insureds	High	High	Medium	Medium	Low	Low	Low
Loss potential to insurer and guarantor	Low	Medium	Medium	High	High	High	High
Cross-subsidisation	Low	Low	Medium	Medium	High	High	High

Source: Worthington (2015, p.33)

The potential for adverse selection is the likelihood that only those at high risk of losses will purchase insurance if the insurer cannot distinguish between risk types and charge a uniform premium for all risk types. Adverse selection tends to be high in some private insurance markets. State-sponsored schemes avoid adverse selection by making insurance adoption compulsory or at least difficult and costly to avoid. On the flipside, government-sponsored schemes often lack the risk-reduction elements because of the uniform premium and its attendant cross-subsidisation. The above analysis suggests that whether market- or government-led, disaster insurance pools works best to enhance the resilience of societies to extreme natural events when it forms part of an overall risk management strategy; without the corresponding efforts to reduce exposure and vulnerability, the risks may become 'uninsurable.'

Figure 1.4: Stylized models for risk transfer in European countries



Source: adapted from Schwarze et al. (2011)

Focusing on European countries, Schwarze et al. (2011) also provide five basic models of how European countries insure against extreme natural events, distinguishing them in terms of the intensity of regulation and state involvement (Figure 1.4). France, for example, has a mandatory inclusion of all natural hazards in all contents insurance policies by way of a uniform surcharge of 12% on the insurance premium. The state acts as an 'insurer of last resort,' offering unlimited reinsurance guarantee through the Caisse Centrale de Rèassurance (CCR). In the UK and Germany, however, private insurers provide coverage for extreme natural events, although the UK and Germany differ slightly: British insurers bundle natural perils with fire insurance while German insurers cover extreme natural events as 'riders' on their fire policies upon request.

In developing countries, however, state-sponsored natural disaster insurance pools are rare. Instead, there are several donor-sponsored regional risk pools, such as the African Risk Capacity (ARC), the Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) and the Caribbean Catastrophe Risk Insurance Facility (CCRIF SPC) as well as pilot parametric insurance schemes. In addition, insurance industry initiatives such as the Munich Climate Insurance Initiative (MCII) work towards making developing countries resilient to extreme natural events through insurance. While these initiatives tend to focus on making insurance accessible to all, evidence shows that demand for the existing disaster insurance is low (Binswanger-Mkhize, 2012; Freeman & Kunreuther, 2003). Understanding why many homeowners in developing countries fail to insure against extreme natural is the central focus of this thesis. Such an insight can inform the design of future natural disaster insurance schemes.

Although some work has been done on the low demand for disaster insurance, they sparsely cover Africa. There are, however, at least two reasons to consider the African case. First, there are hardly national natural disaster insurance programmes in Africa, implying that private markets usually provide coverage. Unfortunately, the lack of reliable data on natural hazard risks in most African countries hampers these insurers' ability to quantify and price extreme

natural events (Charpentier, 2008). Consequently, the ambiguity may cause insurers to either refuse to provide coverage or provide coverage inefficiently, which will make insurance less attractive. Second, culture has been found to influence insurance consumption (Hofstede, 1995; Chui & Kwok, 2008). It is, therefore, vital to examine societal mores in Africa that may hinder disaster insurance adoption. A better understanding of the causes of underinsurance against natural disasters will contribute to improved policy prescriptions.

1.3 Objectives and research questions

The study examines the causes of the low insurance adoption against natural disasters in developing countries, focusing on Ghana, where private insurers provide natural disaster insurance as part of their home insurance policies. Despite the availability of disaster insurance since the early 1960s, only a few homeowners adopt it. Insurance penetration, defined as the contribution of total insurance premiums to gross domestic product, is about 1% in Ghana. This mirrors other African countries, the exceptions being South Africa, 14.36%; Namibia, 6.98%; and Mauritius, 6.43% (Swiss Re, 2016). In examining the causes of underinsurance in Ghana, the study looks at both the supply and demand sides. On the supply side, what factors influence private insurers to baulk at providing coverage or supply coverage in an inefficient manner, making the price unattractive to homeowners? Are data on natural hazards publicly available? To what extent does the provision of disaster aid influence the supply of disaster insurance? Since Ghanaian private insurers already supply disaster insurance, the study focuses on the issue of data on natural hazards and how the lack of it might influence the efficient supply of disaster insurance.

If the insurers lack reliable data on natural hazards and are therefore unable to segregate risks and set premiums based on the average risk of the whole population, adverse selection theory suggests that low-risk individuals may forgo insurance as they find the premium too high while high-risk individuals demand insurance as they find the premium favourable. Aware of this,

insurers may set premium rates that far exceed the average expected loss in order not to make losses (Kunreuther, Meszaros, Hogarth & Spranca, 1995). Such an approach will cause individuals to forgo insurance because the cost seems excessive (Kousky & Cooke, 2012). While the literature discusses the issue of adverse selection extensively, it hardly focuses on how ill-informed insurers price natural disaster risks. This is understandable, given that insurers in most mature insurance markets are well informed about natural hazard risks because of their investments in advanced risk assessment technologies (GDV, 2011).

On the demand side, how do individual cognitive limitations, the provision of disaster aid and culture influence natural disaster insurance adoption? Recent findings from cognitive psychology shed light on why some individual decisions sometimes depart from economic rationality. Since individuals cannot spend all their time thinking and analysing every decision, they resort to using simple rules of thumb. While useful in general, these rules of thumb can lead to systematic errors in decision-making – especially regarding low-probability events such as natural disasters (Kahneman, 2012). The study, therefore, identifies some biases in decision-making that may cause individuals to forgo insurance. For political and altruistic reasons, governments (and private organisations) sometimes provide disaster aid to uninsured victims of natural disasters. The study discusses how the provision of disaster aid by government agencies may impact the demand as well as the supply of disaster insurance.

Finally, the study explores cultural influences on disaster insurance adoption by testing whether the degree to which individuals believe they can control their environment influences disaster insurance adoption. In Ghana, like in most African societies, the idea that fate or supernatural forces determine life outcomes holds sway. Therefore, many believe that supernatural forces cause natural disasters. Such beliefs may cause them neglect to undertake risk mitigation measures, such as insurance adoption. The study uses the locus of control construct to test whether the extent to which one believes in fate influences disaster insurance adoption.

The first approach was to identify the causes of underinsurance against natural catastrophes from the existing literature. Covering the relevant theoretical approaches as well as the available empirical evidence, chapter two of the thesis reviews the economic, insurance and psychology literature to understand alternative economic and behavioural explanations for the lack of disaster insurance, especially in developing countries. The chapter identifies economic, political and psychological explanations for the failure by many property owners to insure against extreme natural events. The findings may be broadly classified into factors affecting the supply and factors affecting the demand for natural disaster insurance. On the supply side, asymmetric information between insurers and homeowners appears a significant factor hindering the supply of disaster insurance, especially in developing countries. On the demand side, individual cognitive limitations also lead them to underestimate or neglect to purchase disaster insurance.

Chapter three examines how Ghanaian insurers respond to homeowners who invest in disaster risk reduction through a field experiment. It assesses how the lack of information about natural hazards influences the pricing decisions of insurers. It was found that Ghanaians insurers do not reward investments in risk reduction, with some charging higher premiums for buildings with investments in risk reduction, suggesting that the insurers interpret such preventive measures as a sign of high risk. This failure to reward investments in precautionary measures results from a lack of information on the part of insurers and may discourage insured homeowners from investing in risk reduction and make insurance unattractive to those who invest in risk reduction.

The fourth chapter explores how individuals' worldview may influence their disaster insurance purchasing decisions by conducting a household survey on insured and uninsured homeowners in a suburb of Accra. Respondents were asked to complete the Internal Control Index (ICI), which measures beliefs about control outcomes. The study then tests whether locus of control

orientation influences demand for disaster insurance and finds that individuals who believe that luck, fate, or supernatural forces control what happens to them are less likely to purchase disaster insurance, compared with those who believe they control their own destiny. The fifth chapter summarises the work.

1.4 List of publications

This is a cumulative dissertation, made up of three peer-reviewed articles, two of which have already been published and the third, currently under review.

a. Antwi-Boasiako, B. A. (2014). Why Do Few Homeowners Insure Against Natural Catastrophe Losses? *Review of Economics, 65*(3), 217-240.

b. Antwi-Boasiako, B. A. (2016). Insurance and flood risk reduction in Ghana: do insurers penalise homeowners who take precautionary measures? *Environmental Hazards*, 15(4), 343-355.

c. Antwi-Boasiako, B. A. (2017). It's beyond my control: the effect of locus of control orientation on disaster insurance adoption. *International Journal of Disaster Risk Reduction, 22,* 297-303.

Chapter 2 Why do few homeowners insure against natural catastrophe losses?

Antwi-Boasiako, B. A. (2014). Why Do Few Homeowners Insure Against Natural Catastrophe Losses? *Review of Economics, 65*(3), 217-240.

Submitted: 26 August 2014
Accepted: 1 December 2014
With permission by publisher (De Gruyter Oldenbourg) to be included in a dissertation

Abstract

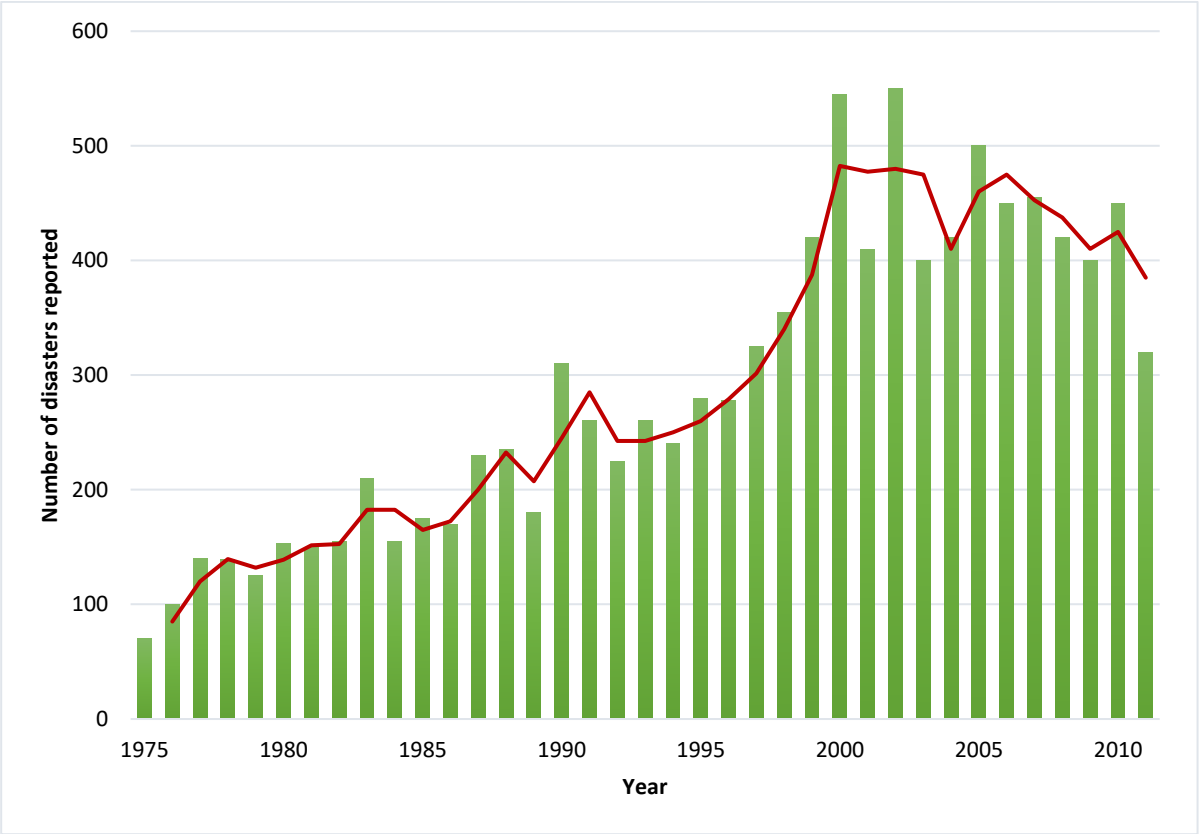
Insurance has been suggested as a policy instrument that can help in managing the rising economic cost of natural catastrophes. Evidence, however, shows that many homeowners do not insure their homes against natural catastrophes and tend to depend on (unreliable) disaster aid. This paper surveys the economics, insurance and psychology literature to explain why few homeowners insure against natural catastrophes. The paper covers the relevant theoretical approaches as well as the available empirical evidence and possible policy measures.

Key words: Insurance, natural catastrophes, government intervention, uncertainty.
JEL: D8, H1, Q54

Natural catastrophes – such as earthquakes, floods, hurricanes, tornadoes and volcanoes – are resulting in huge financial losses. Over the last three decades, the economic cost of these events has risen steadily (Munich Re, 2013). Some studies attribute it to socio-economic changes, which have placed more people and assets in harm's way (Changnon, 2003; Bouwer, 2011). Climate change is also expected to increase the frequency, intensity, spatial extent, duration and timing of some of these events (Wigley, 2005; Rockström et al., 2009; Gleick et al., 2010; IPCC, 2012). As Figure 2.1 shows, the number of reported natural catastrophes across the world is rising. Academics and policymakers alike have, therefore, focused attention on insurance as a policy instrument to reduce financial losses resulting from natural catastrophes. At the international level, for example, Article 4(8) of the United Nations Framework Convention on Climate Change (UNFCCC) draws attention to the possibility of insurance-related actions to deal with the adverse effects of climate change (United Nations, 1992). Similarly, Article 3(14) of the Kyoto Protocol identifies insurance as a means to protect vulnerable countries (UNFCCC,

1997). Furthermore, Paragraph 19(k) of the Hyogo Framework for Action (UNISDR, 2005), Paragraph 1(c) of the Bali Action Plan (UNFCCC, 2008) as well as Paragraph 28 of the Cancun Adaptation Framework (UNFCCC, 2011) all recommend insurance-related solutions to enhance the resilience of societies against extreme weather events.

Figure 2.1: Natural catastrophes reported, 1975 – 2011



Source: EM-DAT: The OFDA/CRED International Disaster Database, 2014

The role of insurance in managing natural catastrophes can be classified into risk reduction and impact reduction. If well designed, insurance can reduce risks by (a) encouraging would-be homeowners to avoid risky areas as the cost of insuring a building situated there is relatively high, (b) encouraging homeowners to reduce risk (for example, retrofitting a building to safeguard it against floods) in exchange for reduced premium, and (c) reducing exposure by requiring that certain minimum standards are met before granting insurance coverage (for example, building codes) (Freeman & Kunreuther, 2003; Warner et al., 2012). Insurance can also reduce the impact of natural catastrophes by spreading losses over space and time as well

as among diverse social and commercial communities (Cimato & Mullan, 2010). If a homeowner bears the cost of damage to her home all by herself, the impact can be devastating. However, if she pools her risk with other homeowners through insurance, the loss is spread among several individuals, thus 'softening the blow' (Jacques, 1847). Additionally, the premium represents a predictable cost, which facilitates planning (Duut-Otterstrom & Jagers, 2011) and gives the policyholder peace of mind as she does not need to worry about the possibility of losing her property.

The merits of insurance notwithstanding, many residential buildings do not have natural catastrophes insurance. Germany provides a classical example. Approximately 98.5% of buildings are eligible to be insured against flooding (1.5% of buildings requiring customised insurance policies as they are in flood-prone areas). Despite this, roughly 72% of homeowners choose not to insure against flood losses (German Insurance Association [GDV], 2011). For some, the decision not to insure may be the best option; for a given asset value at risk, it may be optimal to remain uninsured since a loss may be small relative to individual's wealth. Ehrlich and Becker (1972) show that depending on an individual's wealth, it may be better to try to reduce the probability or the size of a loss than to insure. Additionally, low-income households may also consider catastrophe insurance as a discretionary expense that should be incurred only if residual funds are available after taking care of their basic needs (Kunreuther & Michel-Kerjan, 2009). Whyley, Kempson and McCormick (1998), for example, found 52% of the poorest fifth of households in the UK were without personal property insurance.

Beyond the explanations already discussed, this paper reviews the economics, insurance and psychology literature to explain why some private homeowners may be uninsured against natural catastrophes. The paper explains various theoretical approaches and gives an overview of the referring empirical evidence. It also discusses policy measures that have been proposed to address the issues. Finally, the paper assesses whether the theory may apply in the context of

natural catastrophe insurance. The possible motives for not purchasing homeowner insurance are categorised into market failure (section 2.1), government failure (section 2.2) and individual cognitive limitations (section 2.3). Market failure here refers to situations in which the market does not offer adequate (and affordable) natural catastrophe insurance. Government failure refers to the behaviours of public actors that may result in low demand for insurance or high cost of supplying coverage. Individual cognitive limitations occur when due to bounded rationality, individuals fail to insure even though it might be the rational thing to do. Section 2.4 concludes the review.

2.1 Market failure

This section discusses issues that may cause private insurers to balk at supplying insurance coverage or only supply coverage at a price that homeowners find unattractive.

2.1.1 Adverse selection

In market insurance, the risk type of the applicant determines the premium. Insurers, therefore, need some relevant (background) information about applicants to calculate premiums that reflect individual risks. In the absence of relevant information, an insurer may base premiums on the average loss of the whole population. However, individuals whose risks are lower than the population average (low-risks) may find the average premium expensive and forgo insurance. Conversely, those whose risks exceed the population average (high-risks) will find the premium favourable and buy (more) insurance. For example, an insurer may estimate – based on historical records – that 1% of buildings in a given city flood yearly. Suppose each building costs €10,000; the insurer might charge a premium of €100 per building.[4] However, some buildings might be situated in flood-prone areas, with a 2% probability of being flooded in a year. Those building owners would be most willing to purchase insurance at €100 since

[4] Found by multiplying the value of the building by the likelihood of a loss (i.e., 10,000 x 1%), assuming there are no administrative expenses and the insurer just wants to break-even.

their risk-reflective premium is €200. Those less prone to flooding (for example with a probability of 0.05%), by contrast, might choose not to insure since a premium of €100 is too expensive. In the end, the insurer could end up insuring only buildings whose expected cost is €200 per €10,000 rather than the average of €100 per €10,000. Therefore, at a premium of €100 for everyone, the insurer will lose money. If the insurer raises the average premium, more individuals with low risks will forgo insurance.

Nineteenth-century insurers coined the term adverse selection to denote the tendency for high-risk individuals to demand (more) insurance while low-risk individuals forgo it (Baker, 2003). However, the theoretical grounding of adverse selection is relatively recent. In his seminal paper, Akerlof (1970) showed how asymmetric information between sellers and buyers in a used-car market may lead to market failure. He showed that if the buyers know that half of the cars are of poor quality but cannot differentiate them from good cars, they will be unwilling to pay more than an average price for both high and low-quality cars. Accordingly, high-quality car owners will leave the market as they will be unwilling to sell at the average price. This will result in buyers decreasing the price they are willing to pay for a used car, thereby leading to the collapse of the market for quality cars. Rothschild and Stiglitz (1976) also show that in a competitive and unregulated insurance market, market equilibrium can fail due to the propensity for high-risks to demand more insurance because they have more or better information than insurers.[5]

The theory of adverse selection has been influential in the regulation of insurance markets (see Siegelman, 2004). However, it is sometimes difficult to observe empirically. Studies that test for correlation between risk level and demand for insurance have produced mixed results. Table

[5] Asymmetric information may be absent, but regulations that forbid insurers from charging risk-reflective premiums may lead to what Polborn, Hoy and Sadanand (2006) term as *regulatory adverse selection*.

2.1 gives a snapshot of some of the studies, indicating the insurance type, the country the study focused on and whether adverse selection was observed. Chiappori and Salanie (2000), for example, focused on drivers with fewer than three years driving experience in France and found no evidence that high-risk drivers opted for comprehensive coverage while low-risk ones chose restricted coverage. Cohen (2005) also examined new motor insurance customers protected under an Israeli insurer. Whereas coverage and accident risk for drivers with fewer than three years of driving experience did not correlate, the study found a correlation for drivers with more than three years' experience. Cohen and Siegelman (2010) provide a comprehensive survey on studies on adverse selection. They argue that the different conclusions from such studies do not mean they conflict with each other because the extent to which adverse selection exists depends on the type of the insurance product, the characteristics of buyers, as well as institutional and regulatory factors. They contend that some factors vary across insurance markets and pools, both in their existence and scale, and that may explain why risk level and insurance coverage may not always correlate.

Table 2.1: Some empirical studies on adverse selection in insurance markets

Insurance Type	*Evidence of Adverse Selection*	*No evidence of Adverse Selection*
Automobile	Puelz & Snow (1994); US Cohen (2005); Israel	Chiappori & Salanie (2000); France Saito (2006); Japan
Health	Cutler & Reber (1998); US	Cardon & Hendel (2001); US Fang, Keane & Silverman (2008); US
Crop	Just, Calvin & Quigging (1999); US Makki & Somwaru (2001); US	-
Annuities	Finkelstein & Poterba (2004); UK Finkelstein & Poterba (2002); UK	-
Life	He (2008); US	Cawley & Philipson (1999); US Hendel & Lizzeri (2003); US, UK and Japan
Long-term care	-	Finkelstein & McGarry (2006); US
Reverse mortgage	Cutler & Zeckhauser (1997); US	Davidoff & Welke (2005); US

To address the challenge of adverse selection, governments (especially in developing countries) may provide information on areas that are prone to natural catastrophes to minimise information asymmetry. This will help insurers to charge risk-based premiums. Another policy intervention may be a direct state provision and/or a compulsory catastrophe insurance to prevent low-risk individuals from skipping insurance (Schwarze & Wagner, 2004). Some countries, such as Spain, Turkey and Switzerland have compulsory state-provided natural catastrophe insurance schemes. However, constitutional issues have been raised in Germany about making natural catastrophe insurance compulsory (Schwarze & Wagner, 2007). Some have also objected to state provision of insurance on grounds of efficiency (see Priest, 1996). In the view of Harrington (2000), making insurance compulsory to control adverse selection simply forces low-risk individuals to subsidise high-risk individuals. Nonetheless, Epple and Schaefer (1996) argue that the then publicly-owned building insurance company in the German state of Baden-Wurttemberg covered natural catastrophes at 'extremely favourable' prices when it enjoyed a monopoly. However, when the monopoly was abolished in favour of competition in the mid-1990s, it resulted in limited coverage and higher premium rates due to higher operating costs. Von Ungern-Sternberg (2004) also examines property insurance markets in Britain, Spain, France, Switzerland and Germany and concludes that direct state provision of natural catastrophe insurance is relatively efficient.

Beyond the above policy measures, insurers also try to minimise adverse selection through underwriting. The insurance principle of *utmost good faith,* for instance, requires insurance applicants to disclose all known material facts about the subject matter of insurance. Concealing such information may allow the insurer to void the policy, which the laws in many countries support. In the English case of *Rozanes v. Bowen (1928)*, for example, Lord Justice Scrutton observed:

> …as the underwriter knows nothing and the man who comes to him to ask him to insure knows everything, it is the duty of the assured… to make a full disclosure to the underwriter without

> being asked of all the material circumstances. This is expressed by saying it is a contract of the utmost good faith (Chartered Insurance Institute, 2010: 6/7).

Rothschild and Stiglitz (1976) show that insurers also screen applicants by offering different menus of contract – one with low deductible but high premium and the other with high deductible but low premium. This results in high-risk individuals choosing the plan with low deductible with low-risk individuals choosing the plan with low premium. Besides, insurers learn the risk types of policyholders over time (Cohen & Siegelman, 2010).

Jaffee and Russel (1997) suggest that adverse selection is not sufficient to explain the market failure for natural catastrophe insurance in all cases. This is because disaster-prone areas are sometimes known by both parties, if not better by insurers. German insurers, for example, have developed what they call the *ZÜRS Geo Zoning System*, an online database which provides access to areas at risk of flooding within the country (GDV, 2011). British insurers also have available risk maps containing detailed information about flood-prone areas (Lamond, Hammond & Proverbs, 2009). Thus, insurers may have superior information or better predictive power than policyholders with respect to natural catastrophes. Nonetheless, adverse selection could be an issue in most developing countries as information (for instance, hazard maps, database of catastrophes and so on) is often not readily available. Insurers may not have the incentives to develop them due to the initial cost involved.

2.1.2 Moral hazard

Aside from information, actions too can be hidden from insurers. After an insurance policy has been initiated, the insurer cannot reasonably observe the behaviour of the policyholder. Since the policyholder no longer bears the financial cost of a loss, she may be less cautious, and the insurer may not be able to observe this change in attitude. This attitudinal change may increase the probability and severity of a loss. As in the example discussed under adverse selection, suppose there is no hidden information, and the insurer correctly establishes the probability of

a house (valued €10,000) being damaged as 1%. The premium that reflects the risk would be €100. After being insured, however, the probability of a loss may rise to 1.5% because the policyholder may become less cautious. At a premium of €100, the insurer would not collect enough money to be able to pay potential claims. If the insurer increases the premium to cover expected loss, it may reduce the appeal of insurance to low-risks.

Moral hazard, like adverse selection, is an old insurance concept that has been formalised by economists. Arrow (1963) analysed the economics of the growing health care sector of the US economy. While explaining his reasoning for public support in the provision of health insurance, he discussed the moral hazard of insurance. He defines moral hazard as 'the effect of insurance on incentives' (Arrow, 1963, p. 961). Pauly's (1968) comment on Arrow (1963) faulted insurance writers (who viewed moral hazard as a question of morality) for using 'emotive words' when discussing moral hazard. He argued that the problem of moral hazard in insurance has little to do with morality, adding, 'the response of seeking more medical care with insurance than in its absence is a result not of moral perfidy, but of rational economic behaviour' (Pauly, 1968, p. 535). Baker (1996) provides an account of why insurers historically saw[6] moral hazard as a question of morality. In the early years of fire and life insurance in England, insurance was seen as 'a form of gambling, a handmaiden to crime, and, above all, a presumptuous interference with Divine Providence' (Baker, 1996, p. 255). To refute that insurance broke with conventional morality, insurers tried to deny insurance to people they

[6]This view has not entirely changed. For example, one *Dictionary of Insurance* defines moral hazard as 'character, habits and actions of insureds… that influence the possibility and extent of a loss. Carelessness, unreliability, poor lifestyle, dishonesty are the unfavourable characteristics that insurers guard against or avoid' (Bennett, 2004, pp. 221-212). Redja (2008, p. 5) distinguishes between moral hazard and morale hazard. He defines moral hazard as 'dishonesty or character defects in an individual that increase the frequency or severity of a loss.' Morale hazard, on the other hand, is defined as 'carelessness or indifference to a loss because of the existence of insurance.'

considered ‘moral hazards’ (that is, people with doubtful character) and designed policies such that it did not tempt people to cause a loss (Baker, 1996).

The literature on moral hazard has since been further developed by economists (see, for example, Zeckhauser, 1970; Ehrlich & Becker, 1972: Shavell, 1979; Stiglitz, 1983; Arnott & Stiglitz, 1991). The literature distinguishes between *ex-ante* and *post-ante* moral hazard. The former refers to the tendency for insureds to be less inclined to take preventive measures that could reduce the probability of a loss. The latter refers to the tendency for insureds to be less inclined to mitigate losses.

Table 2.2 shows some empirical studies on moral hazard in the insurance industry, which examine the relationship between insurance purchase and loss. Chiappori, Durand and Geoffard (1998) found that when co-payment system was introduced in the French health insurance market in 1994 (instead of the 100% cover the existed prior to the change), it had no effect on doctor’s office visits but influenced doctor home visits. Cohen and Einav (2003) focused on the US following mandatory seatbelt usage law in the US. They found no evidence that increased seatbelts usage correlates with riskier driving.

With respect to policy interventions to address the problem, allowing insurers to charge risk-reflective premiums may help to control moral hazard. When individuals know that their claim record affects their future premium, they may exercise care even though they may have insurance. Mullins (2004) compares motor insurance in Canadian provinces and suggests that allowing risk-pricing reduces moral hazard. He found that between 1993 and 2002, provinces that allowed risk-pricing had an annual claim rate of 8-10% while the claim rate was approximately 38% for British Columbia, which did not allow risk-pricing.

Table 2.2: Some empirical studies on moral hazard in the insurance industry

Insurance Type	*Evidence of Moral Hazard*	*No evidence of Moral Hazard*
Automobile	Cummins & Tennyson (1996); US Mullins (2004); Canada Dehejia & Cohen (2004); US	Cohen & Einav (2003); US Abbring, Chiappori & Pinquet (2003); France
Health	Cardon & Hendel (2001); US Chiappori, Durand & Geoffard (1998); France	Chiappori, Durand & Geoffard (1998); France
Crop	Chambers (1989); US	-
Workmen Compensation	Fortin & Lanoie (2000); US Kaestner & Carrroll (1997); US	-

Insurers also try to control moral hazard by not providing 100% coverage; they use risk-sharing measures such as deductibles, co-insurance, upper limits and exclusions (Shavell, 1979; Holmstrom, 1979; Priest, 1996). The deductible is the amount or percentage of loss that the policyholder bears before the insurer pays a claim. With co-insurance, the policyholder and the insurer share losses per a pre-agreed formula. Upper limit is where an insurer provides coverages worth less than the full value of the insured property (for instance, a building may be worth €10,000, but the insurer limits its liability to about €8,000). The effect of all these is that the insured bears part of losses and therefore may be more likely to take preventive measures and mitigate losses. Other measures that indirectly control moral hazard include the fact that claims are often not immediately settled after a loss. Therefore, the time lag between the loss occurring and settling the claim may prompt the insured to take precautions. Moreover, insurers do reserve the right to settle claims by rebuilding instead of making direct payments. While in practice insurers mostly settle claims by way of direct payments, the fact that they reserve the right to rebuild if they suspect moral hazard can also serve as a check on ex ante moral hazard.

Both *ex-ante* and *post-ante* moral hazard may occur in natural catastrophe insurance. Jaffee and Russel (1997) argue moral hazard is unlikely in natural catastrophe insurance because policyholders rarely have influence over the probability of natural events. However, while

policyholders may not be able to reduce the probability of an event, they can reduce the likelihood of damage to their property through self-protection (by retrofitting a building, for instance). The presence of insurance may diminish the incentive to undertake such measures. A policyholder may also place unwanted household items in harm's way (placing furniture in the basement, for example). Ex-post moral hazard may occur if an insured tries to claim more than the actual cost of a loss. The latter may be controlled by investigating losses, but the cost of doing so may outweigh the benefits – at least in the short-term.

2.1.3 Correlated risks

A common phrase among insurers is that with insurance, 'the losses of the few are paid for by the many'. The law of large numbers allows insurers to do this because by examining the aggregate historical losses, they can predict future losses with more accuracy than individuals. While many individuals face the risk of fire damage, usually, only a few are affected per event (although who exactly will be affected is often uncertain). While the aggregate losses remain undiminished, insurance helps to minimise individual losses by distributing losses among several individuals (Jacques, 1847). In other words, insurers can bear risks because they can diversify losses across many policies. However, the spreading of risk is limited when a single event (like most natural catastrophes) affects many the populace. Insurers may consider such correlated risks (sometimes called *fundamental risks* by insurers) as uninsurable (Berliner, 1985; Chichilnisky & Heal, 1993; Tol, 1998; Redja, 2008; Charpentier, 2008).

For insurers to cover such risks, they must demonstrate the capacity to do so by holding large amounts of liquid capital. However, they may be unwilling to do so due to accounting, tax and take-over risks (Jaffee & Russel, 1997; Harrington, 2000). Kousky and Cooke (2012) show that because solvency-constrained insurers who cover such risks must show that they have access to enough capital, they tend to charge premiums that far exceed the expected losses. Budget-constrained homeowners may consider the premium too expensive and forgo insurance.

Additionally, homeowners are likely to skip insurance if they perceive insurers may not be able to pay claims in the event of a catastrophe (Doherty & Schlesinger, 1990). According to Turner (2013), over 92,000 lawsuits were filed in the US by households against insurers for non-payment or delayed payment of claims after Hurricane Ike in 2008. Such incidents may discourage homeowners from buying insurance.

Many studies advocate state involvement as a risk carrier or a reinsurer to help to address the issue (Cummins, 2006; Schwarze & Wagner, 2004; Charpentier, 2008; Charpentier & Le Maux, 2014). Charpentier and Le Maux (2014), for example, argue for state provision of natural catastrophe insurance as the probability of a government program failing is lower. The merits and demerits of state provision of catastrophe insurance has been discussed in under adverse selection (Section 2.1.1, p. 21).

An additional policy measure will be for governments to provide reinsurance support to private insurers to incentivise them to provide coverage. Insurers may reinsure part of the risks they cover via reinsurance companies to stabilise their underwriting results and reduce variance. The availability and affordability of reinsurance is, therefore, crucial for insurers to supply natural catastrophe insurance. This is not a concern for only poor countries with limited private reinsurance capacity. In France, for example, the government acts as the insurer of last resort, which allows the private market to be able to access reinsurance at relatively cheaper prices.[7] In the UK, following a 'gentlemen agreement' between insurers and the state in 1961, private insurers have provided coverage for natural catastrophes as part of the standard home insurance policies (Swiss Re, 2012). However, the Association of British Insurers (ABI) entered an agreement with the government in June 2013 to establish a Flood Insurance Fund ('Flood Re')

[7] However, this arrangement has been criticised by Jametti & von Ungern-Sternberg (2004), who claim that due to the uniform premium rate and the fact that reinsurance is optional, only bad risks are transferred (reinsured) to the state-owned reinsurer while private insurers retain the good risks.

to begin operations in 2015. The not-for-profit insurance fund will be owned and managed by the insurance industry. According to the ABI's (2014) website, *Flood Re* will 'ensure that those domestic properties in the UK at the highest risk of flooding can receive affordable cover for the flood element of their household property insurance.'

Usually, insurers try to overcome the challenge of correlated risk by avoiding a concentration of risk in one geographic area and seeking reinsurance support for risks they accept. However, in developing economies where risk information is not readily available and the (re)insurance markets are not well developed, obtaining affordable reinsurance from the international market could be a challenge. The state may thus act as a reinsurer to induce supply and demand coverage for natural catastrophe instead of proving ex-post disaster relief to uninsured victims. However, such a policy should be carefully designed to minimise inefficiency and avoid a situation in which only the high risks are passed on to the state.

2.1.4 Time inconsistency

For most individuals, owning a house (a capital good) is a major single financial investment. If insurance is available, an individual may initially want to insure her building against natural catastrophes as long as she owns the building. However, with time, both the insurer and the homeowner will learn about risk types; areas that are prone to natural catastrophes will be known by both parties. A homeowner whose property turns out to be in a hazard-prone area may have to contend with sharp increases in her premium or may be required to comply with more stringent conditions. On the other hand, a homeowner who learns over time that her area is not prone to catastrophes may also cancel her policy or move to an insurer who is ready to insure her at a rate that reflects her low risk. The insurer may thus be left with only high probability risks. This may arise because neither party is willing to commit to a long-term contract for practical reasons. Even if we were to adopt John Rawls' (1971) idea of 'veil of ignorance' so that the terms of a policy (agreed upon in a state of ignorance) cannot be varied,

it is doubtful if policyholders can be compelled to stick with a particular private insurer. Focusing on the health insurance market, Cochrane (1995) shows how policyholders who suffer long-term illness may have their policy cancelled (or see their premiums rise sharply) whereas those who (are fortunate to) stay healthy may move to a competitor who charges a relatively cheaper premium.

In an empirical study on the UK home insurance market by Lamond, Hammond and Proverbs (2009), 3% of the participants reported being refused renewal because their neighbourhood had become flood-prone. Also, with a volcano eruption on the UK's island of Montserrat looming in 1997, homeowners there had their insurances canceled (von Ungern-Sternberg, 2004). It is however hard to find empirical studies that show that policyholders failed to renew their policies because they considered themselves safe.

A direct state provision may be a policy measure – the merits and demerits have been discussed. Following the private market reluctance to continue to insure flood risks in the US, for example, the National Flood Insurance Program (NFIP) was initiated in the late 1960s (Kriesel & Landry, 2004). Kunreuther, Michel-Kerjan and Pauly (2013) also proposed long-term insurance contracts as a possible policy option. Under this proposal, instead of policies being renewable annually, both parties would be tied to a contract for a longer period with a fixed or risk-indexed premium, paid annually. It is not exactly clear how both parties can be tied down to such a contract – can a homeowner who is dissatisfied with the services of an insurer be compelled to stay for years? Even in Germany where long-term insurance contracts are common, a recent change in the insurance contract law allows policyholders to cancel policies after three years, irrespective of the agreed duration of the original contract (Schirmer, 2010).

Time inconsistency applies in natural catastrophe insurance. Due to changes in climate and socio-economic factors, those who live in hazard-prone areas and those who do not may change over time. Locations considered safe today may turn out to be unsafe tomorrow and vice versa.

2.2 Government failure

This section concerns government actions that can lead to low demand or high cost of supplying natural catastrophe insurance. Regardless of the market issues discussed above, in some countries the private market or state provides coverage at reasonable prices. Even with subsidised premiums (flood insurance in the US, for example), some people living in hazard-prone areas fail to insure. One possible explanation is that the disaster aid governments provide in the aftermath of natural catastrophes may tempt some individuals not to insure, which is discussed below.

2.2.1 Samaritan's dilemma/Charity hazard

While the financial assistance governments (and others) provide after natural catastrophes is helpful to the victims, it may affect the demand for natural catastrophe insurance since the assistance may be seen a premium-free insurance (Kaplow, 1991; Harrington, 2000). This is a type of 'Samaritan's dilemma' (Buchanan, 1975; Coate, 1995) or 'charity hazard' (Browne & Hoyt, 2000; Raschky & Weck-Hannemann, 2007). Browne and Hoyt (2000, p. 293) define charity hazard as 'the tendency of an individual at risk not to procure insurance or other risk financing because of a reliance on expected charity from others such as friends, family, community, non-profit organisations, or a government emergency program.' The effect is that as more people would be uninsured and thus unable to recover, the government is then pressured to assist the victims. This does not only affect the demand for insurance, but also the supply, as insurers retreat from the market because it is unprofitable to offer insurance coverage against natural catastrophes due to low demand (Raschky & Weck-Hannemann, 2007).

A few empirical studies exist which examine the concept of charity hazard. Kunreuther et al. (1978) and Burby et al. (1991) found individuals and communities did not base their risk management decisions prior to natural catastrophes on expected government aid. Kunreuther et al. (1978) conducted a face-to-face interview with some homeowners exposed to natural catastrophes across the US and found most uninsured residents did not anticipate governmental aid in the event of a disaster. Burby et al. (1991) also found local governments that received more relief after catastrophic events made more efforts to reduce their risks than those who did not. An empirical analysis of the NFIP by Browne and Hoyt (2000) also found a positive relationship between flood insurance purchase and governmental aid, and thus no charity hazard. They argue that exposure to flood risk may increase both insurance purchase and the receipt of disaster aid from government. Van Asseldonk, Huirne and Meuwissen (2002) surveyed the demand for public-private crop insurance program in the Netherlands and found the decision by the producers to participate in the program was significantly associated with their belief about the future availability of disaster aid. Raschky et al. (2013) claim the institutional arrangement of governmental disaster aid (either there is certainty of relief or uncertainty as relief is based on ad hoc decisions) influences demand for insurance. They show that in Austria (where relief is assured), disaster aid drives out private insurers more than in Germany (where relief is uncertain).

Charity hazard suggests governments should refrain from giving disaster relief to encourage individuals to manage their risks. However, it is also called a dilemma precisely because governments are unable to commit to a policy of not helping victims of natural catastrophes. As Kydland and Prescott (1977) argue, individuals factor in their expectations of government action when making decisions. Therefore, they may forgo insurance if they expect the government will provide disaster aid.

Beyond the need for the state to support distressed citizens, politicians may also have political reasons to provide disaster aid. In examining the politico-economic reasons why a proposed mandatory natural catastrophe insurance scheme for Germany failed in 2003, Schwarze and Wagner (2007, p. 413) suggest politicians may benefit from providing disaster aid: 'Chancellor Schröder's energetic and sympathetic efforts to help Saxony during the floods led to the governing party's renewed popularity, helping the Social Democrats to win the 2002 election.' Pulzer (2003, p. 156) makes a similar claim:

> [A] number of factors… influenced perceptions of the parties' and their leaders' performance. The first contingent event was the flooding in the Danube and Elbe valleys in mid-August, in which Schröder displayed almost perfect crisis-management, visiting the stricken areas, mainly in eastern Germany, and instantly promising a €385 million aid package… The electoral pay-off for Schröder's gesture was particularly strong in the eastern Länder.

A study in the US also suggests that all other things being equal, governmental support for disaster victims is common in election years, and states that are considered electorally competitive are twice likely to receive presidential disaster declaration as compared to uncompetitive states (Reeves, 2011).

2.3 Individual cognitive limitations: heuristics and biases

An analysis of the US's National Flood Insurance Program (NFIP) by Kriesel and Landry (2004) revealed that about 51% of eligible properties were uninsured although flood insurance is available at subsidised rates. Given that the NFIP is state-owned, the risk of a non-performing contract is minimised (Doherty & Schlesinger, 1990), and therefore, one would expect consumers to purchase insurance at subsidised rates. Why would some individuals fail to insure, even when it might be in their best interest to do so? Research from cognitive psychology sheds some light on why some individual decisions sometimes depart from economic rationality. Kahneman (2012) tells us that the human mind performs two types of thinking: (a) intuitive and automatic (*system 1*) and (b) reflective and rational (*system 2*). Whereas *system 2* is deliberate

and self-conscious, *system 1* is rapid and instinctive and is used in everyday life. Since people cannot spend all their time thinking and analysing everything, they rely on *system 1* by using simple rules of thumb, which Tversky and Kahneman (1974) termed *heuristics*. These heuristics, while useful in general, can lead to systematic errors in decision-making – especially regarding low-probability events such as natural catastrophes (Kahneman, 2012). This section briefly discusses some biases and heuristics in decision-making that may cause individuals not to insure even though it may be beneficial for them to do so.

2.3.1 Unsullied optimism and safety myth

By viewing the world as more benign than it is, individuals tend to decide based on 'delusional optimism rather than on a rational weighting of gains, losses and probabilities' (Kahneman, 2012, p. 252). This may lead to an 'it-will-not-happen-to-me' mentality, where individuals wrongly perceive themselves as immune from mishaps. A survey of drivers by Svenson (1981) found 90% of participants believing that they were more skilful and less risky than the average driver. In a laboratory experiment by McClelland, Coursey and Schulze (1993) on insurance purchase, many of the subjects bid zero for coverage, probably viewing loss as unlikely and thus not worth being protected against. Studies on market behaviour also reveal over-confidence – investors tend to overstate the present and future values of markets and thus invest heavily in business start-ups (Shiller, 2000). With respect to insurance, an overly confident homeowner may underrate her exposure to natural perils and forgo insurance. This is likely to be the case if she has never been a victim of natural catastrophes. In line with optimist behaviour, a homeowner may prefer not to know her risks, because as Thomas Gray (1747) put it, 'ignorance is bliss.' Insuring against extreme events may imply admitting that they live in a hazard-prone area (Akerlof & Dickens, 1982).

2.3.2 Short-term horizon for evaluating insurance benefits

When choices and their outcomes are separated in time, people tend to undervalue the outcomes – especially regarding things for which the cost is borne now, but the benefits are delayed (Thaler & Sunstein, 2009). Thus, paying a premium now for an intangible good such as insurance while the benefit is delayed (or may never be realised if the event insured against does not occur) may cause individuals to undervalue the benefits of insurance. Insurers claim that insurance gives 'peace of mind', however since it does not eliminate the risk, buying insurance may remind people of their vulnerability to risks (Camerer & Kunreuther, 1989). Slovic et al. (1977) found subjects preferred expensive insurance with the possibility of a partial refund (if there was no claim) over regular insurance. Camerer and Kunreuther (1989) interpret it as a tendency for individuals to view insurance as a form of investment, rather than protection against loss. In other words, if they do not get 'returns' on their 'investment' (that is, if they do not benefit from their insurance policies because they have not suffered any damage), they may be less inclined to continue the insurance after a period.

2.3.3 Status quo bias

Kahneman and Tversky's (1979) prospect theory suggests rather than value net wealth, individuals value gains and losses from a reference point, and the pain of losses from a reference point is worse than the pleasure of equivalent gains (loss aversion). Consequently, individuals tend to stick to their current situations, even when altering it may be beneficial – because the status quo has less uncertainty and the cost of leaving it appear higher than the benefits. Samuelson and Zeckhauser (1988) refer to such behaviour as status quo bias. Whyley, Kempson and McCormick (1998, p. 60) find 20% of the uninsured households in the UK attributed it to the fact that they had 'not got around to taking it out.' Such people were described as insurance conscious, had no strong views about insurance, had no financial problems, had thought about insurance in the past but never managed to purchase insurance. In Germany, while about 90%

of houses are insured against the standard fire risks, only 10% are insured against natural events (Thieken et al., 2006). A possible explanation is that in Germany, homeowners must actively request for catastrophe insurance, so they prefer to take the default option (that is, only the standard fire policy without a natural catastrophe loss coverage). In the UK, where natural catastrophe loss is offered as the default option, roughly 90% of all insured houses are covered against catastrophe losses (ABI, 2005). This also suggests that status quo bias may work the other way around – some homeowners may continue to insure even when insurance is not optimal.

2.3.4 Anchoring effect and availability heuristic

Individuals tend to rely on given or known information to estimate an unknown event (anchoring). In a study conducted by Tversky and Kahneman (1974), participants were asked to estimate the percentage of African countries that are members of the United Nations. Prior to that, the participants had been asked to write down the number they saw after spinning a wheel (unknown to the participants, it had been designed to stop on either 10 or 65). On average, participants who saw 10 estimated that 25% of African countries were members of the United Nations. For those who saw 65, their average estimate was 45%. Thus, the estimates of the subjects were influenced by the number they saw (10 or 65). In other words, the subjects 'anchored' their estimate on the given number, which 'primed' them.

Seen in the context of deciding to insure or not, individuals tend to anchor their outlook of the future on how they perceive their risks today (Kunreuther & Michel-Kerjan, 2009). Individuals also use availability heuristics by assessing the probability of a catastrophic event based on how readily past catastrophic events come to mind (Tversky & Kahneman, 1974). While a recent disaster may influence an individual's perception of risk, most individuals tend to forget about them since natural events have relatively low frequencies. Michel-Kerjan, de Forges and Kunreuther (2012) show that demand for flood insurance rose sharply after Hurricane Katrina

(the 'Katrina Effect'), only to drop a few years later. Johnson, Hershey, Meszaros and Kunreuther (1993) also recount an incident where the sale of earthquake insurance skyrocketed when a self-proclaimed climatologist, Iben Browning, falsely predicted an earthquake on the New Madrid fault in 1990. This also suggests that anchoring effects and availability bias can be exploited to induce insurance purchase.

2.3.5 Mimetic blindness – following the herd

In Hans Christian Andersen's (1837) short tale *The Emperor's New Clothes*, two tricksters succeed in selling non-existing garments to the emperor. This was accomplished by claiming that the unusual beauty of the garments made them invisible to simpletons. Not only the emperor, but his officers and all his subjects (except a little child), deny the evidence in their own eyes and claim to have seen the non-existing garments – all because others falsely claimed to have seen it and none wanted to be seen as a simpleton. One lesson from the story is people tend to conform to what they see others doing, as confirmed in a study by Sherif (1937). A more recent study found it is not the quality of a performance that determines the amount of applause from the audience; instead, the length of an ovation is influenced by the behaviour of other members of the crowd (Mann et al., 2013).

Banerjee (1992) showed that while it may be perfectly rational for an individual to follow what others are doing (herd behaviour), it may lead to what he calls 'herd externality' as the choice of one person positively or negatively influences the choice others subsequently make. In deciding on natural catastrophe insurance, homeowners may be influenced by the decision of their neighbours, friends and others. Kunreuther (1984) provides anecdotal evidence that knowing someone who is insured influences individual's decision to insure. In a pre-test of a questionnaire related to earthquake insurance in San Francisco, a homeowner who had responded that he had no earthquake insurance was eager to learn about it when his friend, listening to the interview, commented he did have earthquake insurance. This may suggest that

a neighbourhood where most residents are insured can induce the other residents to insure too and vice versa.

2.3.6 Misrepresenting risk and ignoring low probability risks

Technical experts and lay people tend to differ on how they perceive risks (Slovic, 1987). A homeowner, for example, may perceive a risk of flood differently from that of an actuary. A homeowner who overrates the probability of a flood event may insure while those who underrate the risk may not insure. Individuals also use threshold models when deciding on low-probability events: if their estimate of the probability of an event is below a predefined threshold, they ignore the event (Camerer & Kunreuther, 1989). For example, an individual may initially perceive the probability of an event (*p)* and then unconsciously set a threshold level (*tl*). If her estimate of $p < tl$, she may not worry about the consequences of the event as she assumes it will not happen to her. In experiments and field surveys, people appear to buy insurance only when the probability of a loss is above a certain threshold, even when the premium is below the expected loss (McClelland, Coursey & Schulze, 1993; Slovic et al., 1977).

To conclude this section, it is worth noting that some of the biases discussed can also induce insurance purchase (for instance, status quo and availability). It is hence possible for policymakers to capitalise on some of these biases to influence individual choices in a manner that is beneficial to the individuals and society. Thaler and Sunstein (2009) propose the concept of 'nudge', which is grounded on two pillars: (i) libertarianism – individuals should have the freedom to choose on grounds of autonomy and welfare; and (ii) paternalism – some form of government intervention is inevitable as governments provide starting points and these affect some preferences and choices. 'Nudge' is, therefore, an approach to influence behaviour by designing and offering free choices for individuals, so that their decisions are more likely to produce outcomes that are beneficial to them and society. This involves carefully-selected

default options, priming and so forth so that individuals may be influenced to choose what is right, *as judged by themselves.* The authors claim 'nudge' can induce savings, donations or to stop some activities like smoking. Indeed, Madrian and Shea (2001) did a study on savings plan for employees of a major company in the US. They found dramatic increases in savings enrolment after the employer automatically enrolled every employee into the plan unless an employee explicitly requested otherwise (a kind of a 'nudge'). Future studies may aim to extend the concept of 'nudge' to natural catastrophe loss insurance by analysing the effect of automatic enrolment/renewal on policyholders' behaviour.

2.4 Conclusion

The paper has highlighted why some homeowners may not buy natural catastrophe loss insurance. While insurers may have clear reasons for not providing coverage in some specific cases, there is no clear evidence for widespread market failures in catastrophe loss insurance. However, it is striking that some homeowners do not insure even when insurance is available at actuarially fair or subsidised rates. This suggests that charity hazard (especially in countries where disaster aid is guaranteed) and risk perception bias may be key reasons for non-insurance. Unfortunately, there are only few empirical studies on charity hazard and risk perception bias, with basically no systematic evidence from developing countries. Future studies should therefore aim at filling these gaps as well as identifying features of an efficient insurance scheme that will be attractive to homeowners.

Chapter 3 Insurance and flood risk reduction in Ghana: do insurers penalise homeowners who take precautionary measures?

Antwi-Boasiako, B. A. (2016). Insurance and flood risk reduction in Ghana: do insurers penalise homeowners who take precautionary measures? *Environmental Hazards*, 15(4), 343-355.

Submitted: 14 March 2016
Accepted: 30 June 2016
With permission by publisher (Taylor & Francis) to be included in a dissertation

Abstract

Today, many advocate insurance as a tool for coping with natural disasters. Beyond providing prompt financial relief to victims of disasters, insurance can also incentivise individuals to invest in preventive measures if insurers reward such efforts with reduced premiums. However, insurers might be unable to reward investments in precautionary measures with lower premiums if they are ill-informed about individual-level risks. Here, we explore how Ghanaian home insurers respond to investments in flood risk reduction by asking them to quote premiums for four identical buildings; two had investments in flood risk reduction, while the other two had none. We find that insurers did not reward investments in risk reduction, with some charging higher premiums for elevated buildings, suggesting they have interpreted such preventive measures as a sign of high flood risk. This failure to reward investments in precautionary measures may discourage insured homeowners from investing in risk reduction.

Keywords: flood insurance, flood risk management, risk awareness, developing countries

Today, the occurrence of an extreme natural event such as a flood commands greater economic costs than a similar event did in the past. Many attribute it to large numbers of vulnerable people and assets in hazard-prone areas (Changnon, 2003; Crompton & McAneney, 2008; Bouwer, 2011; Simmons, Sutter & Pielke, 2012). Climate change also threatens to exacerbate the problem by increasing the frequency, intensity and spatial extent of such extreme natural events (IPCC, 2012). As a result, societies face the challenge of how to incentivise individuals to invest in cost-effective preventive measures and at the same time help the recovery of those who suffer from inevitable natural disasters. Accordingly, many advocate insurance as an effective policy tool for achieving both objectives: It rewards investments in risk reduction with lower premiums and reimburses victims of disasters (Priest, 1996; Kunreuther & Michel-Kerjan, 2009).

Ehrlich and Becker (1972) show that insurance can incentivise individuals to invest in risk reduction if premiums reflect such investments. Insurers, however, are often poorly informed about local idiosyncratic risks with respect to extreme natural events; therefore, charging risk-reflective premiums or adjusting premiums to reflect investments in risk reduction can be a challenge (Charpentier, 2008). In mature markets, insurers address this challenge by investing in advanced risk assessment technologies. German insurers, for instance, have developed an online database – ZÜRS Geo Zoning System – which shows the risk of flooding for every address in the country (GDV, 2011). Australian insurers have also invested in technologies that allow for easy access to hazard information (McAneney et al., 2016). Hence, insurers in these countries can adjust their premiums to reflect investments in risk reduction, thereby incentivising homeowners to invest in risk reduction in exchange for premium reductions.[8]

For insurers in nascent markets in developing countries, however, the upfront costs of investing in advanced risk assessment technologies can be prohibitively expensive, given the low insurance penetration. These insurers therefore settle for a system of broad risk classification; instead of assessing risks for each individual land parcel, they divide a city into broad risk classes and charge a differentiated premium for each class. Under such a broad classification, individuals who know their risks are low will be hesitant to buy insurance if the insurers, unable to observe detailed risk differentials within classes, charge an average premium for each class.

Suppose, for instance, that an insurer determines the annual probability of flooding for different risk classes as follows: Class I, less than 2%; class II, between 2 and 10%; and class III, greater than 10%. In this example, the annual probability of loss for class II varies by a factor of two to ten. If some homeowners in class II have finer estimations of their risks than the insurer, those with probabilities closer to 10% (high-risk) are likely to buy insurance while those with

[8] Some recent studies, however, highlight a certain degree of cross-subsidisation in some mature markets, often driven by concerns about affordability (Surmnski et al., 2015).

probabilities closer to 2% (low-risk) are less likely to buy insurance. Homeowners are likely to know more about their risks for several reasons. They know the exact location of their properties within each risk class and have better information about the construction of their houses: Roche, McAneney, Chen and Crompton (2013) show an example of how elevating floor levels can dramatically reduce flood damage costs in some catchments. Although an insurer can conduct site inspections to get detailed information about every property, doing so could be prohibitively expensive given the low premium involved.

Therefore, once the insurer realises that a disproportionate number of high-risk homeowners in class II are buying insurance, they will be incentivised to raise the average premium for the class to avoid making losses. Such a move could further dissuade the low-risk individuals within that class from purchasing insurance, leading to efficiency loss associated with adverse selection. As Akerlof (1970) shows, asymmetric information between sellers and buyers can lead to an adverse selection of low-quality products. Spence (1973) as well as Rothschild and Stiglitz (1976), however, identify practical ways markets mitigate the adverse selection problem: The well-informed party can take costly actions to signal credible information to the poorly informed party in order to improve on their market outcome (Spence, 1973), or the ill-informed party can screen the well-informed party to know their type by offering different types of products (Rothschild & Stiglitz, 1976). Building on Spence's (1973) work, Feltovich, Harbaugh and To (2002) explain that in some situations – such as where the signal is not the only information available to the poorly informed party – signalling may be interpreted as a sign of insecurity.

This insight has implications for insurance. An insured homeowner might also invest in risk reduction (Hemenway, 1990), and if the risk reduction measure renders the construction non-standard – for example, if the building is elevated – the insurance doctrine of utmost good faith obliges the homeowner to disclose such a measure to insurers. (We will come back to this issue

in later discussion.) In a market where insurers are well-informed about individual-level risks, such investments should lead to premium reductions to incentivise further investments in risk reduction as Ehrlich and Becker (1972) derived. But if insurers are poorly informed about individual-level risks, they might interpret such risk reduction activities as a sign of higher risk: Why elevate a building if it is not in a flood-prone area?

This exploratory study investigates whether Ghanaian property insurers reward investment in flood risk reduction with premium reduction or interpret it as a sign of high flood risk. To our knowledge, this is the first time that this issue has been explored in a developing country. Most other studies have been done in mature insurance markets (Pasterick, 1998; Thieken et al., 2006; Botzen, Aerts & van den Bergh, 2009; McAneney et al., 2016). Although these studies clarify how insurance coverage and investment in risk reduction interact, they do not focus on asymmetric information between insurers and homeowners. That is reasonable, given that insurers in those mature insurance markets may be well-informed about risk levels.

We focus on Ghana because of the availability of natural disaster insurance and the country's exposure and vulnerability to natural hazards, particularly flash and pluvial floods. In Ghana, unplanned urbanisation has led to the construction of houses in floodplains (Karley, 2009). The capital city, Accra, is particularly prone to flash and pluvial floods because of its low elevation, lack of drainage systems and developments in floodplains (Rain, Engstrom, Ludlow & Antos, 2011). Karley (2009) traces flooding in Accra to the 1930s: When a massive earthquake wreaked havoc on the city in 1939, the ensuing housing shortage led some residents to encroach on lands along water courses. Today, about 41% of Accra's land area lies between high and medium flood risk zones (Nyarko, 2000). The city has suffered seven severe floods in the last five years: 5 May 2010; 22 June 2010 (35 deaths); 24 February 2011; 1 November 2011 (14 deaths); 31 May 2013; 6 June 2014; 4 July 2014; and 3 June 2015 (190 deaths) (Daily Graphic, 2015).

Given Ghana's poor land use planning, insurers could encourage investment in cost-effective risk reduction measures by rewarding investments in precautionary measures with lower premiums. The insurers, however, cannot play such a role if they are unable to observe individual-level risks. Ghana, therefore, is an excellent place to explore the interaction between insurance and disaster risk reduction in the context of a developing country.

3.1 An overview of the Ghanaian insurance market

In 1924, the then Royal Exchange Assurance Corporation of the United Kingdom started operations in Ghana, and following Ghana's independence from Great Britain in 1957, a state-owned composite insurance company was set up. Today, the Ghanaian insurance market is one of the fastest growing markets in Africa, comprising 18 life and 23 non-life insurers (Timetric, 2014). Between 2009 and 2013, the industry grew at a compound annual growth rate of 30.4%, as compared with other African countries, such as Chad, 2.3%; Ivory Coast, 3.9%; Cameroon, 9.4%; and Uganda, 18.8% (Timetric, 2014). The market is mainly a private commercial company market, and is opened to foreign competition with one German-owned (Allianz) and several Nigerian-owned companies. The state-owned insurer, SIC Insurance Company, was partly privatised in 2007; because state agencies are no longer obliged to insure with the company, its market dominance has since reduced.

Insurance penetration, defined as the contribution of total insurance premiums to gross domestic product, is about 1% and only one in ten Ghanaians own any kind of insurance (Ernst & Young, 2016). The majority of insurance policies are sold directly; brokers and agents each hold about 25% of the market (Ernst & Young, 2016). The market is fragmented, and competition is based mostly on price, not on service. While the insurance of commercial buildings is compulsory, residential buildings insurance is optional. Like Australia, Britain and Japan, Ghanaian insurers have 'bundled' the coverage of extreme natural events with their home insurance policies. Therefore, the standard home insurance policy provides coverage against losses from floods (all

types), earthquakes, tornadoes, volcanoes and storms. This contrasts with what pertains in countries such as Belgium, Germany, Italy and some states in the US, where insurers agree to extend their home insurance policies to cover extreme natural events on payment of additional premium. Although a 'bundled' system permits cross-subsidisation, well-informed insurers can still charge differentiated premiums since not everyone who buys home insurance will be exposed to every natural hazard. Ghanaian insurers are not subjected to direct rate controls by the state; therefore, they have the freedom to charge risk-reflective premiums.

3.2 Data and methods

To get realistic data for the study, we employed a correspondence design (a type of audit study). Audit studies are field experiments designed to measure discrimination (Pager, 2007). In an audit study, researchers pair individuals who match as closely as possible except for one variable to test whether the subjects will treat the testers differently. For example, researchers testing for racial discrimination in job markets may match two individuals with similar personal attributes (such as age, height, weight and education) except for race and let them masquerade as job applicants to see whether the subjects will evaluate the phony applicants differently.

The audit approach was pioneered in the 1970s (Hakken, 1979), and researchers have since applied variants of it to many settings, including racial discrimination in the US job market (Pager, 2003), insurers' underwriting decisions in Milwaukee in the US (Squires & Velez, 1988), and performance of AIDS counsellors in Germany (Gigerenzer, Hoffrage & Ebert, 1998). A common criticism of the audit methodology is that testers may not appear identical to the subjects (Heckman & Siegelman, 1993). Correspondence studies address this criticism by using fictitious paper applications, which allow for the features of the testers to be made identical across groups and do not entail face-to-face interactions, thus avoiding potential experimenter effects (Neumark, 2012).

Rather than asking insurance companies how they respond to homeowners who invest in flood risk reduction, we presented a pair of two similar buildings to them in the context of real insurance proposal forms. In the first pair were two analogous buildings in flood-prone areas, but one had been elevated by one metre to reduce flood risks whereas the other had not. To confirm if the elevation would affect their decisions, we also asked them to quote for a second pair of adjacent buildings in a relatively safe area and where again one had been elevated and the other had not. Table 3.1 summarises the key attributes of the four buildings, labelled *A*, *B, C* and *D;* Figure 3.1 also illustrates the buildings. Given that both buildings *A* and *B* were in areas the city authorities (AMA, 2015b) classify as flood-prone, the premiums should reflect how the insurers perceive the risk levels of the two properties. Adding *C* and *D* allows for comparison of the premiums for the two elevated buildings; since buildings *A* and *C* were elevated but in different risk locations, the premiums should reveal whether the locations influenced the insurers. Likewise, since buildings *B* and *D* were not elevated but in different risk locations, the premiums should reveal whether the locations influenced the insurers.

Table 3.1: Risk profile of four hypothetical buildings

Investment in flood risk reduction	*No investment in flood risk reduction*
Risky area	
Building A Sum Insured – building: $515,000 Sum Insured – contents: $105,000 Usage: private residential Location: No. 1 Kinshasa Cres., East Legon, Accra Risk reduction: building elevated by 1 metre.	Building B Sum Insured – building: €450,000[9] Sum Insured – contents: €90,000 Usage: private residential Location: No. C542/20 Ashiakle St., Abelemkpe Risk reduction: none
Non-risky area	
Building C Sum Insured – building: $500,000 Sum Insured – contents: $90,000 Usage: private residential Location: No. 6, 4th Circular Rd, Cantonments, Accra Risk reduction: building elevated by 1 metre.	Building D Sum Insured – building: $500,000 Sum Insured – contents: $100,000 Usage: private residential Location: No. 4, 4th Circular Road, Cantonments, Accra. Risk reduction: none

[9] The values for buildings *A* and *B* were identical, but denoted in Euros and Dollars (€1 = $0.8738) to disguise the obvious similarities. In Ghana, it is common for policies to be issued in convertible currencies because the local currency is unstable. We had no reason to believe the currencies influenced the premiums.

Figure 3.1: Illustration of four hypothetical buildings

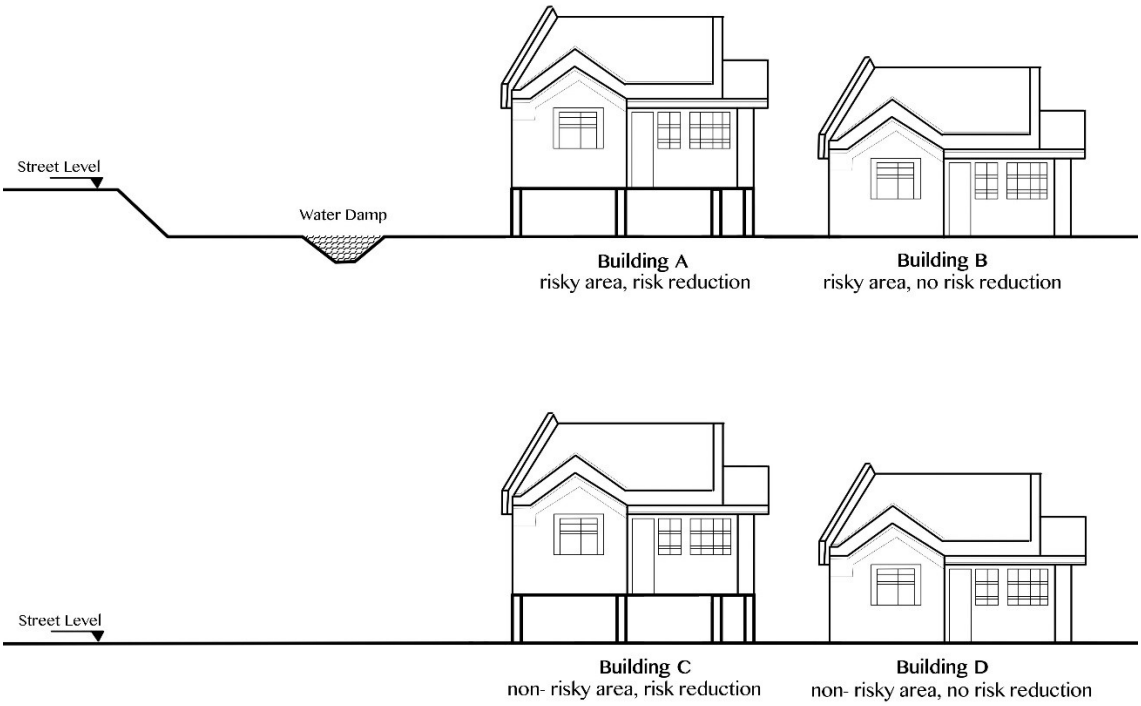
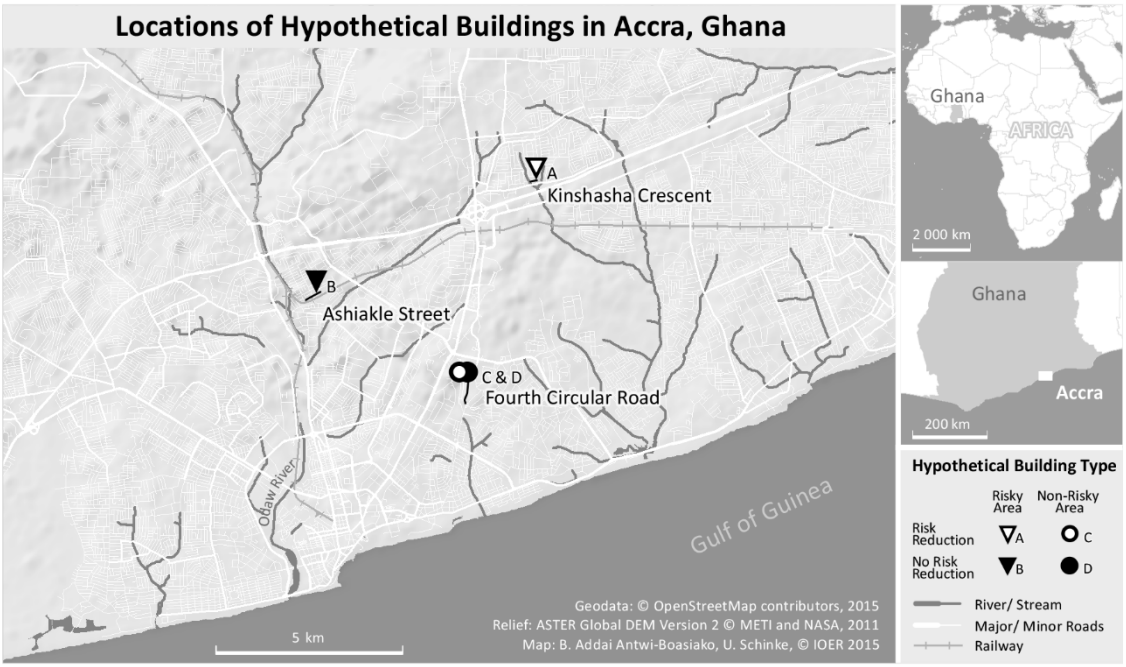


Figure 3.2: Locations of four hypothetical buildings.



All the four hypothetical buildings were in Accra. The city authorities (AMA, 2015b) have designated over 50 areas in the city as flood-prone. In selecting the addresses for the buildings

in flood-prone areas, we needed to ensure that both were equally exposed to flooding. Since it was a challenge to find adjacent buildings in the same street meeting this criterion, we picked two addresses from two different locations (East Legon and Abelemkpe) but each constructed in similar topography and both similarly close to water courses (Figure 3.2). For the buildings in the safe area, we identified two addresses from the same location with similar topography: Fourth Circular Road in Cantonments. Beyond its relative higher elevation, the Cantonments area has a good drainage system; during the colonial period, it was kept exclusively European through a rigid policy of residential segregation (Rain, Engstrom, Ludlow & Antos, 2011). To date, Cantonments accommodates most of the Western Embassies in Accra, including the US Embassy. The city authorities (AMA, 2015a) classify all the areas we chose for the study (Abelemkpe, Cantonments and East Legon) as 'first class residential areas,' making the areas comparable from a socio-economic perspective.

We emailed the insurers to quote premiums for the buildings through an insurance broker between June and September 2015. (Brokers act as intermediaries between insurers and consumers, and are independent of insurers. A broker can ask more than one insurer to quote premiums for a particular risk.) It was possible that if an insurer quoted for one building and did not get a positive feedback from the broker, it might influence the subsequent quotations – the company might quote lower premium just to be competitive. To overcome that, we sent the requests randomly, and to only the insurers with whom the broker deals regularly. That ensured that the four hypothetical buildings were among several other requests for quotations the broker sent to the insurers within that period.

Hence, of the 23 non-life insurance companies in Ghana, we requested quotations from 13 of them. Although it would have been better to have contacted all the insurers, we had to limit it to those with whom the broker regularly deals for the reason given above. The 13 insurers comprise a representative sample of Ghanaian non-life insurers and account for 78% of the

written premium income (National Insurance Commission, 2014). The 13 insurers quoted for all the four buildings; thus, we received a total of 52 quotations.

3.3 Results and discussion

The premiums quoted for the four properties should show whether the investment in flood risk reduction influenced their decisions. We derived the premium rates by expressing the total premium as a percentage of the total sum insured. For example, one insurer charged $1,030 for the structure section of building *A* (valued at $515,000) and $525 for its contents (valued at $105,000), yielding a total premium of $1,555. The total premium ($1,555), as a percentage of the total sum insured ($620,000), gives a premium rate of 0.25%. We used this approach because while some insurers applied a single rate to the total sum insured (that is, structure and contents combined), others split their rates between the structure and contents sections. To simplify the analysis, therefore, we combined all the premium rates; this made no difference because insurers who quoted higher premiums for the structure section of building *A* (compared with building *B*) also quoted higher for the contents section of building *A* (compared with building *B*) and vice versa.

For the two buildings in flood-prone areas (A and B), Figure 3.3 shows the premium rates each insurer quoted as a percentage of the total sum insured. Eight of the 13 insurers (62%) charged similar or greater premiums for the elevated home (building A), four of which were significantly higher. On average, the insurers charged a higher rate for the elevated property (0.24%; standard deviation 0.06%) compared with the non-elevated building (0.21%; standard deviation 0.03%).

In respect of the adjacent buildings in a relatively safe area, 11 insurers (85%) charged similar or greater premiums for the elevated building, four of which were significantly higher. Only two (15%) quoted a higher premium for the non-elevated building as Figure 3.4 shows. On

average, the insurers charged a higher rate for the elevated property (0.23%; standard deviation 0.06%) compared with the non-elevated building (0.21%; standard deviation 0.03%).

However, one can draw wrong conclusions if deductibles are not considered. Insurance policies usually do not completely transfer risks from the policyholder to the insurer because of the problem of moral hazard – the situation whereby individuals have little or no incentive to guard against risk because someone else protects them from the consequences of the risk. For that reason, insurers often require policyholders to bear a portion of the losses to ensure that policyholders retain some incentive to reduce risks. One of the most common ways of doing this is through deductibles. Thus, an insurer may charge the same premium for two properties, but impose a higher deductible on one of them.

Figure 3.3: Premium rates for buildings in risky area (A and B).

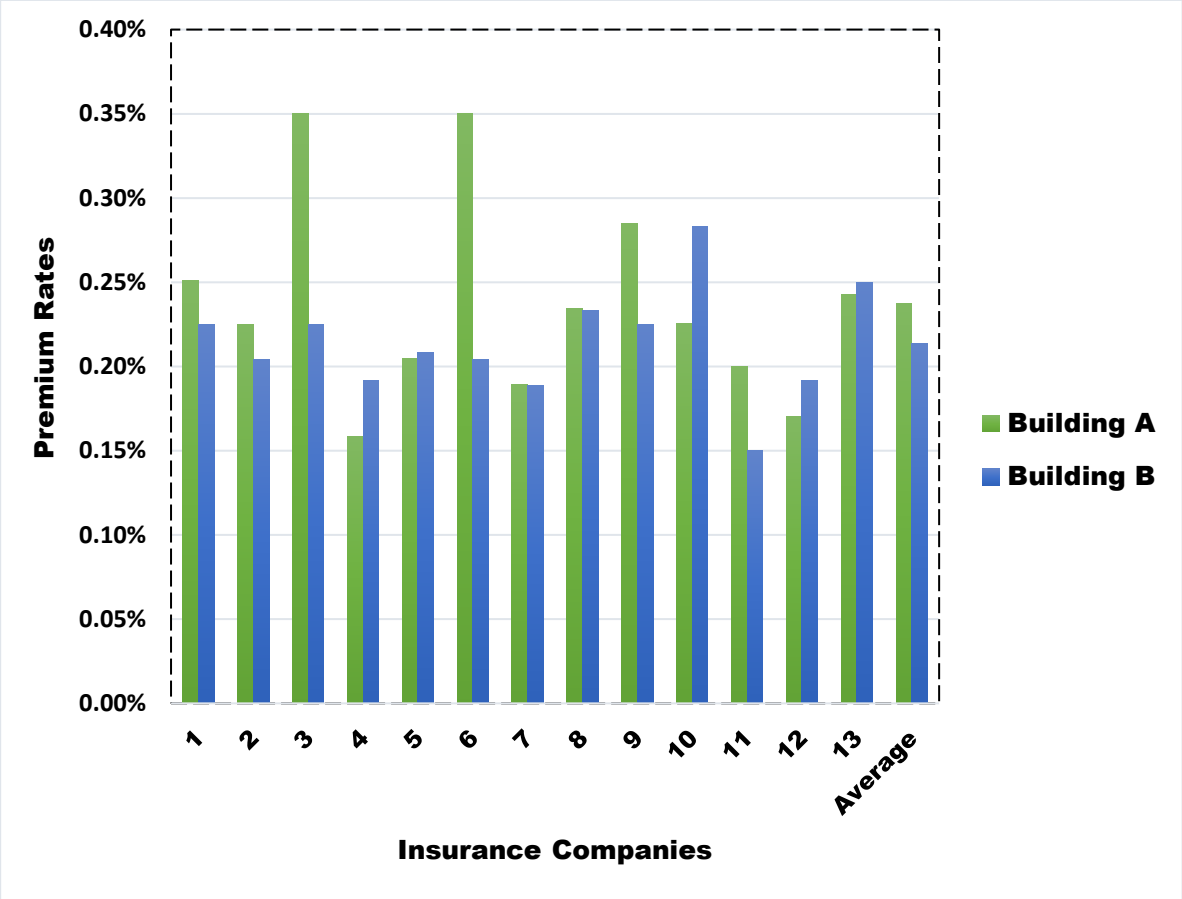
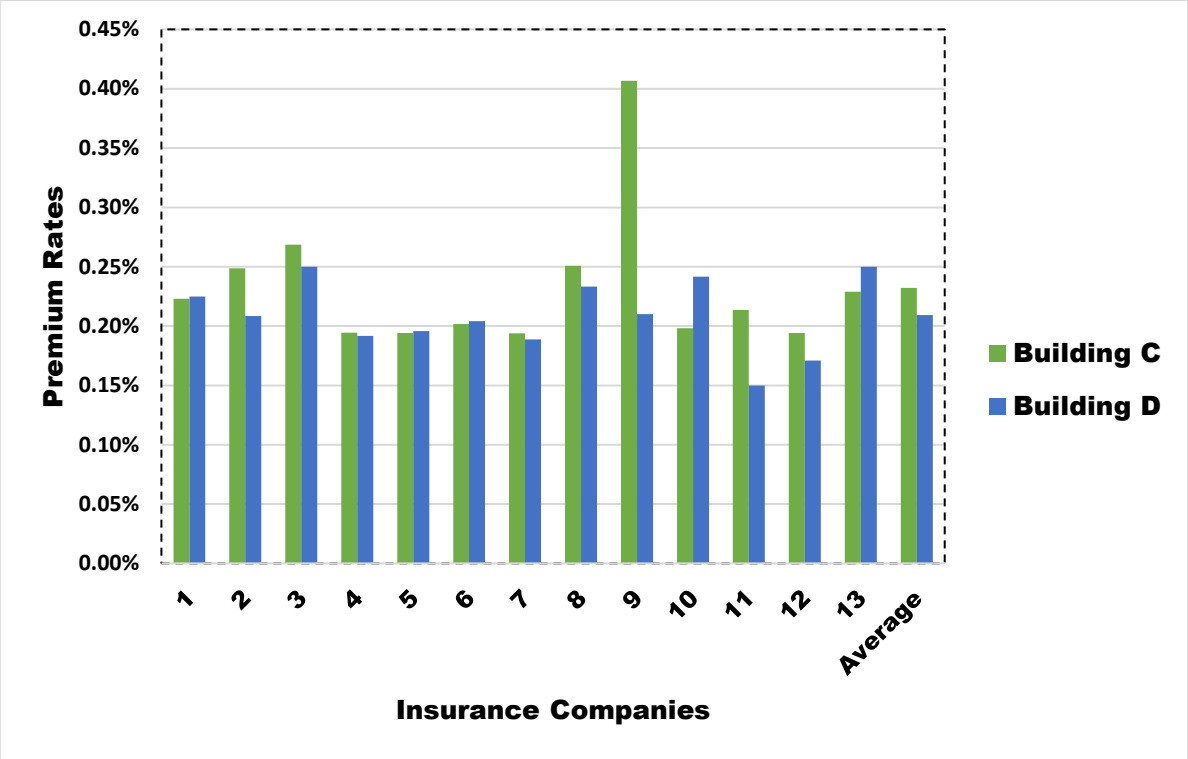


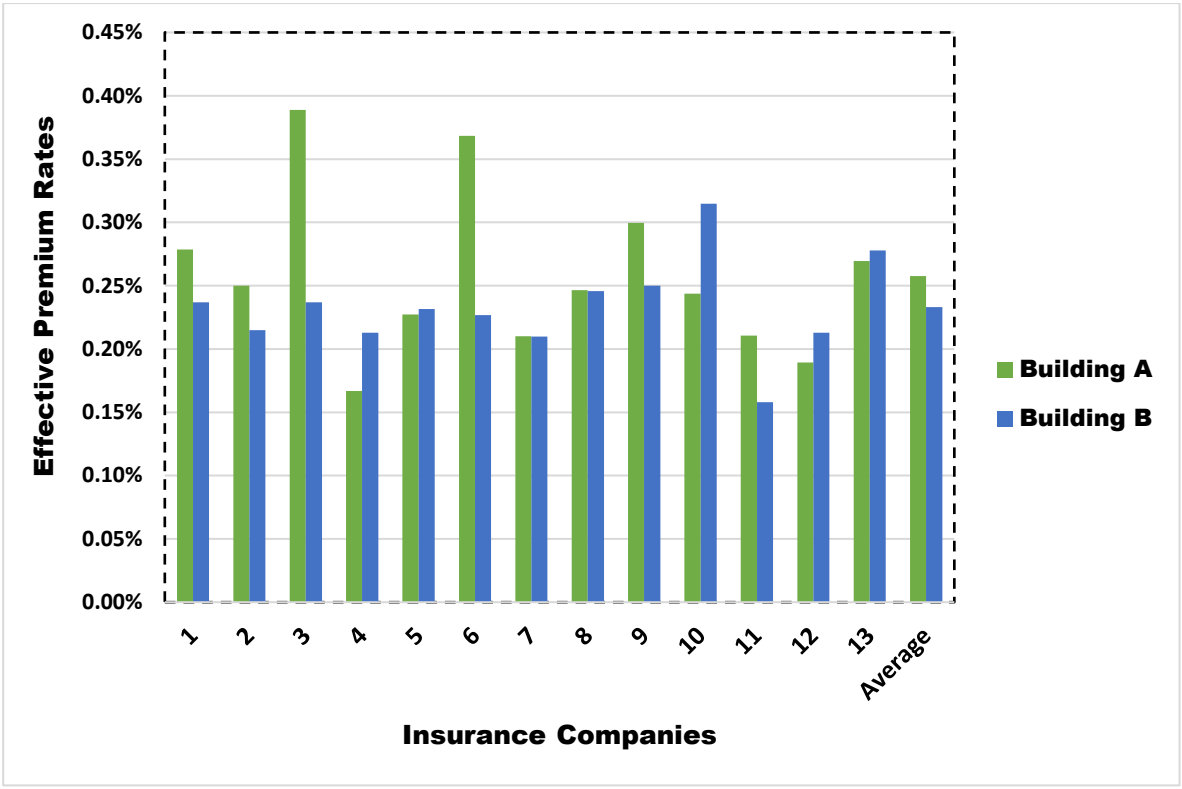
Figure 3.4: Premium rates for buildings in non-risky area (C and D).



Deductibles may be expressed in dollar amounts or percentages or both. The insurers who quoted for our hypothetical buildings expressed their deductibles in percentages. To take the deductibles into account and deduce the 'effective premium rate,' we subtracted the 'uninsured' portion of the building from the total value. For instance, a deductible of 10% on a property worth US$500,000 means that in the event of a total destruction of the building, the insurer's compensation would cover only 90% (US$450,000). This leaves the policyholder 'uninsured' for 10% of the building's value, which is US$50,000. Therefore, if an insurer quotes a premium of $1,500 on a property valued at US$500,000, the premium rate would be 0.30% at face value. However, with a deductible of 10%, it means the premium of US$1,500 is on the US$450,000 (90%) covered by the insurance. The 'effective premium rate' is therefore 0.33% ((1500/450,000) x 100). It is important to look at the 'effective premium rate' because if an insurer quoted the same premium for two buildings but gave different deductibles, it would be misleading to suggest that they charged the same premiums for both buildings.

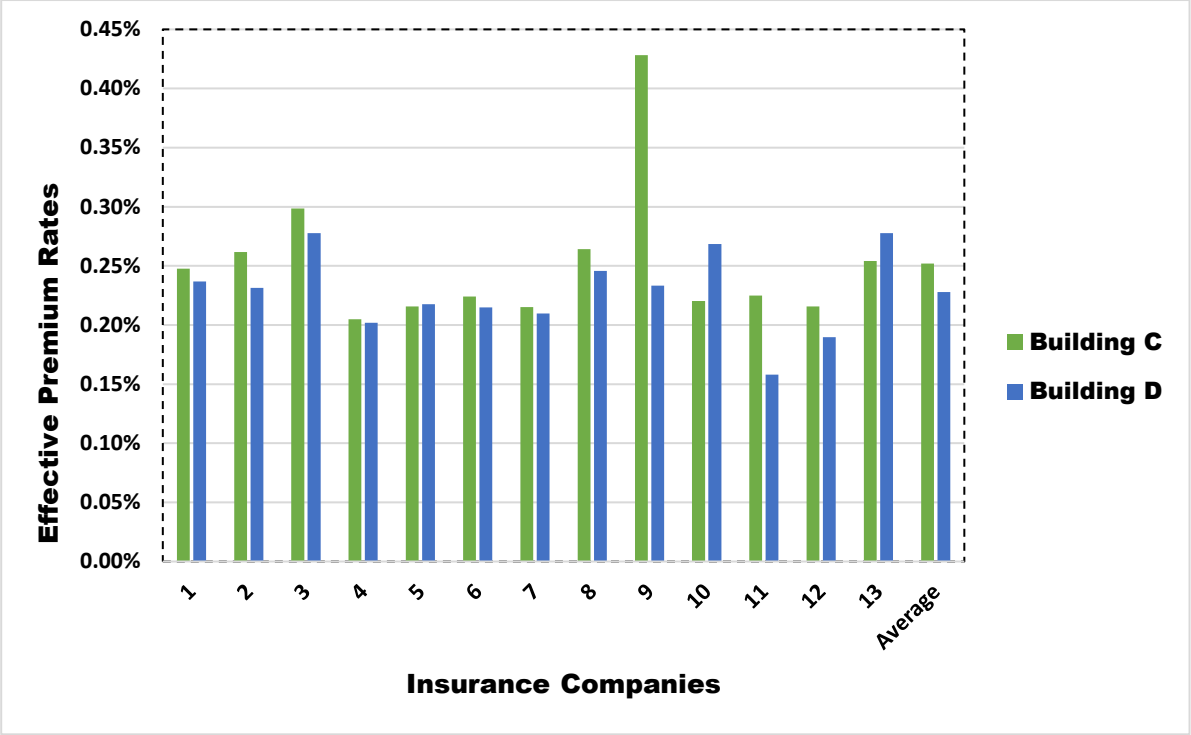
Figure 3.5 shows the 'effective premium rates' the companies quoted for the two buildings in flood-prone areas (*A* and *B*). Even when the deductibles are taken into account, a similar pattern emerges: nine insurers (69%) charged similar or greater premiums for the building with investment in precautionary measures, five of which were significantly higher. The average premium for the elevated building was higher (0.26%) than that of the non-elevated building (0.23%).

Figure 3.5: Effective premium rates for buildings in risky area (A and B)



Regarding the two buildings in the non-risky area (*C* and *D*), 11 insurers (85%) charged similar or greater premiums for the elevated home – after accounting for the deductibles. Despite the similarities in location and the identical features, nine insurers (69%) charged a higher 'effective premium rate' for the elevated building. Two (15%) charged the same premium while the remaining two charged a higher 'effective premium rate' for the non-elevated building. Figure 3.6 depicts the effective premium rates for both buildings.

Figure 3.6: Effective premium rates for buildings in non-risky area (C and D).



The premiums and deductibles the insurers quoted for the four buildings show no reward for investment in risk reduction. They do not, however, fully support our hypothesis that the insurers saw the elevation of floor levels as evidence of higher risk; the differences between the average premium rates for both sets of buildings were not statistically significant. Nonetheless, the results show that under each pair, a higher number of the insurers charged higher premiums for the elevated buildings, compared with the non-elevated buildings. Moreover, although the elevated buildings (*A* and *C*) were in different risk locations (*A* in risky area, *C* in non-risky area), the average premium rates the insurers quoted were almost identical – 0.24% for building *A* and 0.23% for building *C*. Similarly, even though the non-elevated buildings (*B* and *D*) were in different risk locations (*B* in risky area, *D* in non-risky area), the insurers seemed to judge both risks as equal; the average premium for both buildings was 0.23%. These suggest that the locations (irrespective of its risk level) had no influence on the premiums. The elevation, however, seemed to have influenced their decisions – although we acknowledge the differences were statistically insignificant.

Earlier studies on the interaction between insurance and disaster risk reduction suggest that insurers may not reward investments in risk reduction with lower premiums because they may be unsure of the efficacy of such preventive measures (Thieken et al., 2006). Kunreuther and Michel-Kerjan (2009) add that some homeowners do not invest in risk reduction measures because they misperceive their risks owing to unsullied optimism and overweight short-term cash expenditures on risk reduction. Our finding hints of another reason: some homeowners may not invest in risk reduction to avoid signalling to insurers that their risks are high.

Insurance contracts are governed by the doctrine of utmost good faith, which obliges applicants for insurance to disclose all relevant information about their risks. If a policyholder submits a claim and the insurer discovers that the policyholder concealed some material information during the application, the insurer can repudiate the claim. The laws in many countries support this position. For example, in the English case of Rozanes v. Bowen (1928), Lord Justice Scrutton observed:

> [A]s the underwriter knows nothing and the man who comes to him to ask him to insure knows everything, it is the duty of the assured [applicant]... to make a full disclosure to the underwriter without being asked of all the material circumstances. This is expressed by saying it is a contract of the utmost good faith (Chartered Insurance Institute, 2010, p. 6/7).

In Ghana, elevating a building makes it a non-standard construction, necessitating its disclosure to insurers as utmost good faith demands. However, if by disclosing it they end up paying higher premiums, then homeowners may have no incentives to invest in risk reduction. This may aggravate natural disaster losses since some homeowners will not invest in natural disaster risk reduction for fear of paying higher premiums. Also, those who invest in risk reduction may not want to purchase insurance, although they would have bought it if the premium reflected their risk reduction activities. And without insurance, they might expect disaster assistance from the state in the event of a catastrophe.

We are cognisant of the possibility of the insurers quoting higher premiums for the elevated buildings because of previous experiences with elevated buildings – probably because of poor workmanship – or because they had historical claims records for those buildings. However, if they had had adverse experiences with elevated buildings, one would have expected them to want to know more about the elevated buildings. Even though insurers rarely conduct site inspections when providing coverage for residential buildings, an inspection may be necessary when the risk is considered too high. In our study, only two insurers (15%) asked to undertake site inspection before granting coverage. Moreover, none of the insurers imposed any special terms and conditions on any of the buildings. It is also unlikely that all the insurers who quoted higher premiums for the elevated buildings had historical claims records for those properties; buildings *C* and *D* were next to each other and, therefore, historical records of floods should affect both, and not just the elevated building. Moreover, only one insurer would normally insure a property at a given time, making it unlikely that seven or more insurers had historical claims records on the same property.

Generally, access to data on extreme natural events in developing countries is lacking as only few collect such data and when they do so it is rarely shared (World Bank, 2010). For example, we needed to identify flood-prone areas in Accra to locate our hypothetical buildings, but obtaining such data from various public agencies took almost two weeks, although that information was prepared ostensibly for public consumption. We cannot emphasise enough the need for reliable, comprehensive and publicly available data on natural hazards in developing countries to guide homeowners in their decisions about risk reduction as well as aid insurers in their underwriting and pricing decisions.

3.4 Conclusions

The paper explores how Ghanaian property insurers respond to homeowners who invest in disaster risk reduction. The results show no reward for homeowners' investments in risk

reduction. Instead, the insurers were likely to charge higher premiums for homeowners with investments in risk reduction, suggesting that the insurers might have perceived the investment in risk reduction as a sign of higher risk. The failure to reward investments in precautionary measures could discourage investment in preventive measures, which may exacerbate, rather than reduce, natural disaster risks in Ghana. We recognise that this study is exploratory and its findings incomplete. The potentially important policy implications of its findings call for deeper investigation to help us understand why the insurers do not reward homeowners who invest in precautionary measures and rather seem to charge them higher premiums.

For insurance to serve as an effective tool to reduce natural disaster risks in Ghana and other developing countries, both the public and insurers need to be aware of hazard-prone areas and the efficacy of various risk reduction measures. Insurers in developing countries may baulk at investing in advanced risk assessment technologies for economic reasons. Therefore, governments there may have to consider the provision of data on extreme natural event risk as a public good: Higher risk awareness may deter prospective dwellers from living in known hazard-prone areas as well as enable insurers to reward investments in risk reduction measures. There is the need, however, for a trade-off between providing a certain degree of information and too much information for insurers; too much information for insurers may result in premium increases or even withdrawal of insurance from areas the insurers consider too risky.

Chapter 4 It's beyond my control: the effect of locus of control orientation on disaster insurance adoption

Antwi-Boasiako, B. A. (2017). It's beyond my control: the effect of locus of control orientation on disaster insurance adoption. *International Journal of Disaster Risk Reduction, 22,* 297-303.

Submitted: 08 November 16
Accepted: 16 February 2017
With permission by publisher (Elsevier) to be included in a dissertation

Abstract

This paper examines the effect of locus of control orientation on natural disaster insurance adoption among private homeowners in Accra, Ghana. Derived from social learning theory, the locus of control construct can be used to distinguish between individuals by the degree to which they believe they control their own destiny. At one end of the continuum are those with an external locus of control, who believe that luck, chance, fate, or powerful others determine what happens to them. At the other end are those with an internal locus of control, who believe that they can influence what happens to them. This study tests the hypothesis that homeowners with an internal locus of control orientation are more likely to purchase natural disaster insurance than those with an external locus of control. To this end, insured and uninsured homeowners in Accra completed the Internal Control Index (ICI), which measures beliefs regarding control outcomes. The results suggest that more internally oriented homeowners are more likely to be insured against extreme natural events.

Keywords: natural disaster insurance, locus of control, cultural cognition, Ghana

Earthquakes, floods, storms and other extreme natural events threaten the assets of many individuals worldwide. Nevertheless, many homeowners, even those at high risk, fail to insure against such extreme natural phenomena. An example is Californian homeowners' attitudes towards earthquake insurance. In the summer of 1989, Palm and Hodgon (1992) surveyed Californian homeowners to assess their perceptions of earthquake risks and willingness to purchase earthquake insurance. Then, three months later, the 1989 Loma Prieta earthquake struck, wreaking havoc on parts of northern California. Taking advantage of the rare opportunity, Palm and Hodgson (1992) resurveyed the homeowners to compare their attitudes directly before and after the disaster. As expected, they found a significant increase in the

property owners' perception of earthquake risks; however, there was only a slight increase in their willingness to insure against future earthquakes.

Previous studies offer various explanations for the failure by many homeowners to purchase natural disaster insurance (see next section, p. 63). This paper explores whether locus of control can help to explain the low take-up of disaster insurance, especially in African countries. The main argument is that individuals' view of life influences their natural catastrophe insurance purchasing decisions. Who determines the future: luck, chance, fate, supernatural forces, or ourselves? As Bernstein (1998, p. 35) notes, the idea of managing risks 'emerges only when people believe that they are to some degree free agents.' Therefore, individuals who believe they can influence what happens to them are more likely to invest in risk reduction than those who believe external forces, powerful others, chance, or fate controls what happens to them.

In 1756, Rousseau and Voltaire broached the idea of human responsibility for natural disasters following the 1755 Lisbon Earthquake. Approximately two hundred and sixty years later, many still view a natural disaster as an 'Act of God,' believing that such events and their consequences are inevitable (Turner et al., 1986; Paton, McClure & Burgelt, 2006; Smith, 2007). Anecdotal evidence suggests that such beliefs discourage insurance adoption. For instance, in the mid-nineteenth century, a cultural struggle over the morality of insurance in England involved critics attacking insurance as 'a presumptuous interference with Divine Providence' (Baker, 1996, p. 255). In the US, Zelizer (1978, p. 596) notes that some clergy denounced insurance as 'a secular and sacrilegious device that competed against God in caring for the widows and orphans.' Such attitudes extended to investments in preventive measures, as the following case illustrates. In 1783, a property owner in the French province of Artois erected a lightning conductor on his property to reduce the risk of lightning damage, much to the chagrin of the noble citizens, who demanded its removal, lodging the following charges:

> What! Shall we rend the lightning from the hand of God? Shall man presume to intercept the wrath of the Deity? If God wills to destroy houses or farms, it is his will and pleasure – man's duty is to submit. These lightning conductors are but the impious thoughts of Deistical philosophy! Away with them! (Lewes, 1849, pp. 37-38).

While the influence of such societal mores has waned in many parts of the Western world, the idea that fate or supernatural forces determine life outcomes remains dominant in most African societies (Ilife, 1995; Oduyoye, 1997). However, because the analytical focus has so far largely been on societies that have a long tradition of insurance (Surminski & Oramas-Dorta, 2014), scholars have paid little attention to the role of such beliefs in individuals' disaster insurance purchasing decisions. As Smith (2007, p. 47) suggests, those who believe that supernatural forces cause natural disasters may neglect to undertake risk mitigation measures, such as insurance, since they may 'feel no personal responsibility for hazard response and wish to avoid expenditure on risk reduction.' In contrast, those who believe that natural disasters and their effects can be controlled may be more inclined to adopt disaster mitigation measures, including insurance protection.

Testing the hypothesis requires measuring the extent to which homeowners believe they can influence what happens to them. The locus of control construct allows us to do that. Derived from Rotter's (1954) social learning theory, locus of control can be used to distinguish between individuals based on the degree to which they believe their actions cause the consequences they encounter (Rotter, 1966). At one end of the continuum are those with an external locus of control, who believe that luck, chance, fate, or powerful others determine what happens to them. At the other end are those with an internal locus of control, who believe that they can influence what happens to them and try to exert control over their environment (Rotter, 1966; Strickland, 1989). Most people fall somewhere between the two extremes. Locus of control beliefs are reportedly variable over time for an individual and are influenced by cultural and social factors (Rotter, 1966; Marks, 1998). Since individuals with an external locus of control orientation

exhibit general passivity and helplessness (Rotter, 1966), it stands to reason that externally oriented individuals would be less likely to take precautionary measures, such as insuring against extreme natural events.

While locus of control has generated ample research in many contexts, applications to disaster insurance adoption are rare. Earlier studies find individuals with an internal locus orientation are more likely to use contraceptives (MacDonald, 1970), avoid smoking (Clarke et al., 1982), attempt weight loss (Manno & Martson, 1972), mitigate earthquake losses (Simpson-Housley & Bradshaw, 1978), and adhere to asthma medication (Ahmedani et al., 2013). Recent economics research also confirms the influence of locus of control, suggesting that those with an internal locus of control tend to persist in their job search efforts (McGee & McGee, 2016), become entrepreneurs (Caliendo et al., 2014) and complete high school and attend college (Coleman & DeLeire, 2003). This study extends the concept to disaster insurance adoption by focusing on Ghana, where disaster insurance adoption is low, although private insurers have provided coverage since the 1960s.

Before reviewing earlier studies explaining why only a few individuals insure against extreme natural events, it is important to mention other terms in the literature describing the notion that one controls life events. Langer (1975) uses the term 'illusion of control' to denote the idea that some individuals believe they have greater personal control over outcomes than they do, while Bandura (1997) describes the belief that one can achieve what one sets out to do as 'self-efficacy.' Ryan and Deci (2006) also use the terms 'autonomy' and 'self-determination' to describe individuals' desire to regulate themselves and their environment. Despite the conceptual differences underlying the theories behind these terms, they address the core idea that some individuals believe they can influence what happens to them (Judge, Erez, Bono & Thoresen, 2002; Leotti, Iyengar & Ochsner, 2010).

4.1 Some explanations for the low adoption of disaster insurance

Previous studies on why many individuals fail to insure against extreme natural events adopt different perspectives (for a recent survey, see Antwi-Boasiako (2014)). Here, a few of the key works are highlighted. Economic models based on expected utility theory assume that individuals make a cost-benefit trade-off in their insurance purchasing decisions. Therefore, the probability of a loss, the insurance premium, the deductible, the value of the property at risk and the individual's wealth and appetite for risk influence insurance adoption (Smith, 1968). From this perspective, homeowners may consider an insurance purchase as a suboptimal decision and forgo it if they perceive the insurance premium as far exceeding the expected loss (Kousky & Cooke, 2012). These economic models, however, fail to explain why many homeowners still fail to insure, even when the premium is subsidised or actuarially fair (Kriesel & Landry, 2004). Cognitive psychologists and behavioural economists explain this apparent anomaly, which is discussed next.

Broadly, recent findings from cognitive psychology show that individuals often use rules of thumb when judging events since they lack the time, data and mental capacity to evaluate every issue (Kahneman, 2012; Gigerenzer, 2014). While these rules of thumb work well in many instances, they can also produce biases and blunders, especially regarding rare events (Kahneman, 2012). Thus, individuals may ignore risks that they perceive as low (Camerer & Kunreuther, 1989), as they set a probability threshold below which they consider the probability to be zero (Slovic et al., 1977). Even for risks they acknowledge, because they have misjudged it, homeowners might find even a subsidised or an actuarially fair premium to be a bad deal. The implication here is that a government whose objective function is to boost disaster insurance needs to improve the level of risk awareness among homeowners. To this end, Siegrist (1997) suggests using natural frequency formats (instead of probability) to communicate risks

since risks appear larger when they are expressed as natural frequencies. However, as Palm and Hodgson (1992) suggest, risk awareness does not necessarily translate into insurance adoption.

Could expectations of disaster relief discourage disaster insurance adoption? Some scholars argue that expectations of disaster relief hinder disaster insurance adoption since homeowners consider disaster aid to be premium-free insurance (Coate, 1995; Raschky & Weck-Hannemann, 2007). The few available empirical works, however, find limited support for the charity hazard hypothesis. In contrast, those who receive disaster aid are also likely to purchase disaster insurance (Burby, 1991; Browne & Hoyt, 2000). Disaster aid, however, weakens demand for insurance in countries where it is guaranteed by law in comparison with countries where it is based on ad hoc decisions (Raschky et al., 2013) or collectivist societies that prioritise interdependence (Chui & Kwok, 2008).

4.2 Data and methods

To examine the effect of locus of control orientation on disaster insurance adoption, homeowners in Accra, Ghana, were surveyed, utilising Duttweiler's (1984) widely used Internal Control Index (ICI). The ICI consists of 28 items, with response alternatives falling on a 5-point Likert scale ranging from 'rarely' to 'usually.' The questions are worded such that highly internally oriented subjects are expected to answer half of them at the 'usually' end of the scale and the other half at the 'rarely' end of the scale. This produces scores ranging from 28 to 140, with higher scores indicating greater internal locus of control (see Appendix A). Scores below 84 indicate that the respondents believe that external forces control their lives more than themselves. The lower the score is, the stronger the belief is in the influence of external forces. Scores above 84 indicate that the respondents believe that they are in control of their lives. The higher the score is, the stronger the belief in their own influence on their lives. The objective was to examine whether the scores of insured homeowners differed significantly

from those of uninsured homeowners. In addition to the ICI, the respondents also answered questions relating to risk awareness, loss experience and socio-economic status.

There were challenges associated with selecting the sample frame, selecting the sample units and reaching out to the homeowners. These problems as well as how they were overcome are briefly described. Since the objective of the survey was to compare the locus of control orientations of insured and uninsured homeowners, it required interviewing a sufficient number of both insured and uninsured homeowners. However, given the negligible number of insured homeowners in Ghana, failure to survey a significant number of insured homeowners was possible, unless an enormous number of homeowners were sampled. Cost considerations meant that such a large number of respondents was not feasible. To increase the chances of sampling insured homeowners, aggregate statistics of insured homeowners were obtained from a leading insurance company and a major insurance broker in Accra. An area (Ayawaso West Sub-Metro) with a high density of insured homeowners[10] was identified, and the study was restricted to owner-occupied homes in that area. In addition to increasing the chances of sampling insured homeowners, this approach also ensured that the sampled homeowners were homogenous in terms of exposure to extreme natural events and socio-economic status, making a comparison of their locus of control orientations more realistic.

The second challenge was determining the sample size since it was hard to ascertain the number of owner-occupied homes in the selected area. Although information on the number of owner-occupied homes in the chosen area is lacking, official statistics indicate that the population of the Ayawaso West Sub-Metro was 70,667 residents in 14,909 households in 2010 (Ghana Statistical Service, 2012, p. 97). Therefore, the sample size was calculated on the basis of the

[10] There were higher numbers of insured homeowners in other suburbs, but most of them had insured to fulfil mortgage requirements. Since homeowners who had voluntarily purchased disaster insurance were needed for the study, suburbs with more mortgaged homes were ignored.

number of households, yielding a minimum sample size of 400. To subdivide the study area, the electoral division of the sub-metro was followed, and the number of registered voters in each electoral area was used as a proxy for the population within each sub-area. Of the 118 polling stations in the study area, the study focused on 93 since the others were on university campuses and, therefore, without owner-occupied homes. The 13 most populated polling stations had seven sample units each and the six least populated stations had sample units each.

The third challenge involved how to reach the homeowners. In Ghana, as in most developing countries, post office boxes are the primary means of mail delivery to private homes. These boxes are located on the premises of the post office station, meaning there is no 'door-to-door' delivery of mail. In addition, a house may be in District 'A', while the post office from where the household collects letters may be in District 'B'. Hence, it was impractical to send the questionnaires by mail. A household drop-off approach (Steele et al., 2001) was therefore adopted. With the assistance of eight university graduates who were familiar with the area, the survey instruments were hand-delivered to the respondents at their homes between April and May 2016, affording the homeowners the opportunity to seek clarification. The respondents could also complete the questionnaires when it was most convenient for them (and indicate when the completed surveys could be picked up), thereby increasing the response rate.

Finally, even in the area with relatively high insurance adoption, it was expected that only a few insured homeowners would be reached by random sampling; therefore, the plan was first to sample both insured and uninsured homeowners near each polling station randomly. Then, after retrieving the completed questionnaire and knowing the number of respondents who were insured, the second strategy was to focus on insured homes only, using insurance status as a qualifying question. Table 4.1 shows the number of distributed and retrieved questionnaires associated with the two approaches. Since there were no significant discrepancies between the

responses of the randomly sampled and purposively sampled insured homeowners, the responses were combined, and the results are presented in the next section.

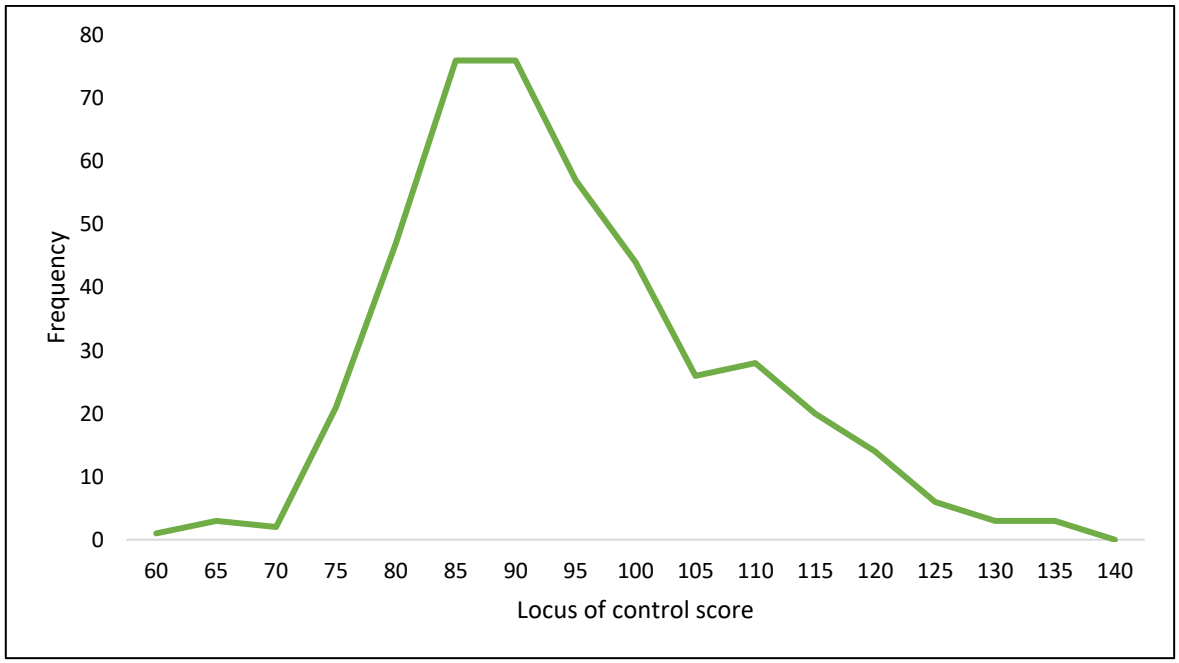
Table 4.1: Summary of distributed and retrieved survey questionnaires

Approach	*Distributed*	*Responses*	
		Insured	*Uninsured*
Random sampling	450	127	235
Purposive sampling	83	67	-
Total	*533*	*194*	*235*

4.3 Results

Out of the 429 usable completed questionnaire, 194 (45%) of the respondents were insured, while 235 (55%) were uninsured. Figure 4.1 shows the distribution of the locus of control scores for all the respondents. As expected, most respondents fell between the two extreme ends of the continuum. Additionally, the average scores of both groups were above 84, which is the standard outcome. For example, Duttweiler's (1984) original work examined 1,365 junior college, university undergraduate and continuing education students and found average Internal Control Index scores between 99.3 and 120.8 for various groups within the sample.

Figure 4.1: Distribution of locus of control scores for all respondents



Next, the scores of insured and uninsured respondents were compared. As Figure 4.2 shows, insured respondents scored higher on the locus of control scale. A one-way Welch ANOVA was conducted to determine if the difference in the scores for insured and uninsured homeowners was statistically significant. The results show that the difference was statistically significant, Welch $F(1, 348.298) = 66.717$, $p < .0005$. Table 4.2 provides additional descriptive statistics and shows that, on average, the locus of control scores for insured homeowners ($n = 194$, $M = 97.42$, $SD = 14.038$) was higher than those for uninsured homeowners ($n = 235$, $M = 87.50$, $SD = 10.390$). These results suggest that homeowners with a stronger belief in their ability to control their destiny are more likely to have disaster insurance than those who believe that luck, fate or supernatural forces control what happens to them.

Figure 4.2: Comparison of locus of control scores for insured and uninsured respondents

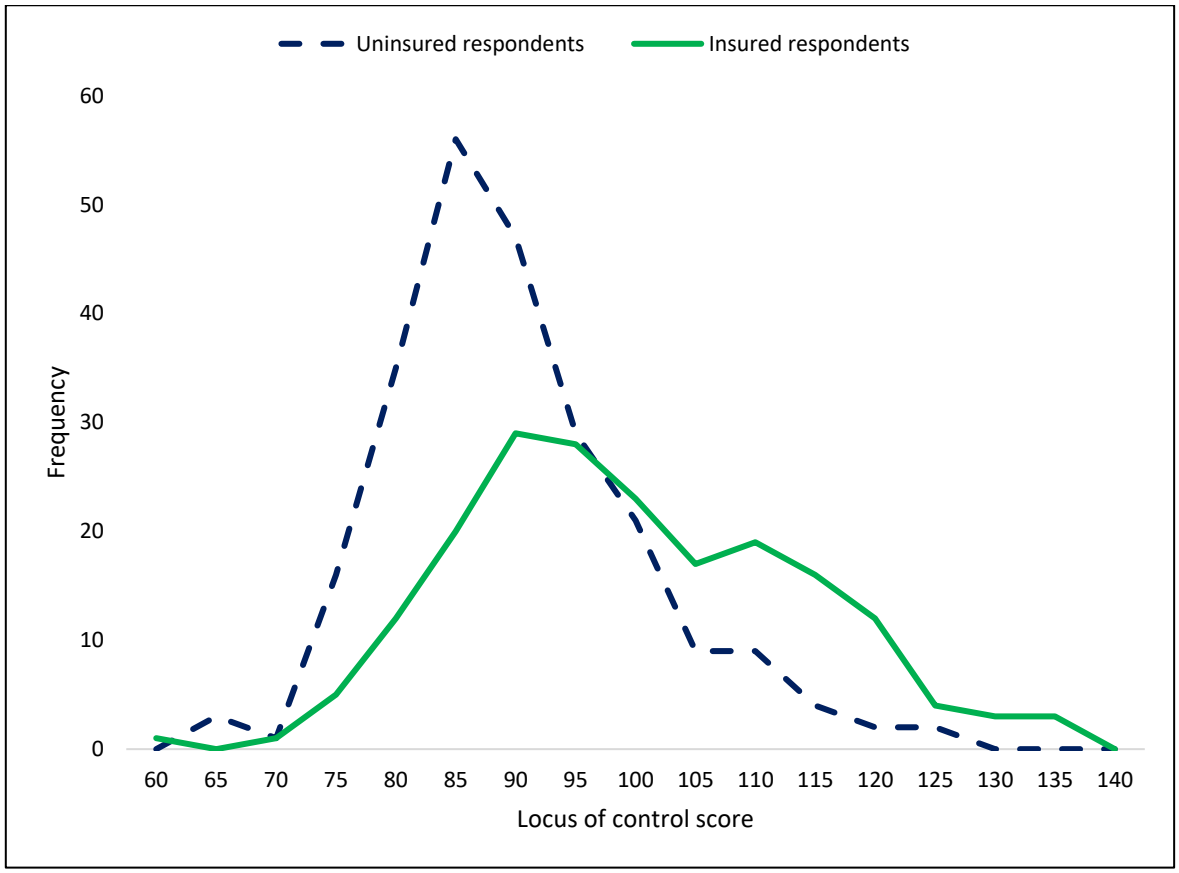


Table 4.2: Average locus of control scores for insured and uninsured homeowners

	N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for the Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Uninsured	235	87.50	10.390	.678	86.17	88.84	61	124
Insured	194	97.42	14.038	1.008	95.43	99.41	60	135
Total	429	91.99	13.127	.634	90.74	93.23	60	135

Welch ANOVA, however, tells us only whether the locus of control scores of insured homeowners differ significantly from those of uninsured homeowners. It does not indicate the relative importance of the other determinants of disaster insurance adoption. Therefore, a logistic regression analysis was performed to ascertain the effects of education (highest qualification), wealth (value of the building) and risk perception on the likelihood that respondents had insurance coverage. Logistic regression analysis allows us to isolate each of these factors to determine its net effect, holding constant the influence of the other factors. It makes it possible to statistically model the effect of each determinant on the likelihood of being insured.

Table 4.3: Logistic regression model predicting the likelihood of being insured based on locus of control, the value of the building (wealth), level of education and risk perception

		B	S.E.	Wald	df	p	Odds Ratio	95% C.I. for the Odds Ratio	
								Lower	Upper
Step 1[a]	Locus of control	.066	.009	49.455	1	.000	1.068	1.049	1.088
	Value of the building	.070	.081	.732	1	.392	1.072	.914	1.257
	Level of education	-.044	.093	.221	1	.638	.957	.798	1.148
	Risk perception	-.010	.111	.008	1	.929	.990	.797	1.230
	Constant	-6.272	.871	51.817	1	.000	.002		

The logistic regression model was statistically significant, X2 (4) = 65.741, p < .0005. The model explained 19.0% (Nagelkerke R2) of the variance in disaster insurance adoption and correctly classified 69.9% of the cases. Of the four predictor variables (locus of control, value

of the building, level of education and risk perception), only locus of control was a statistically significant predictor of disaster insurance adoption (Table 4.3). A higher locus of control score was associated with an increased likelihood of being insured. Given the homogeneity of the sample, the non-significance of the other factors was expected. For example, 73% of the respondents had completed at least high school, 88% had never experienced a loss and 78% responded it was 'not likely' that they would experience a loss. However, a higher locus of control score was correlated with a higher level of education.

The result suggests that the degree to which individuals believe they control life events influences their disaster insurance purchasing decisions. In other words, those who believe they control their destiny are more likely to have disaster insurance for their home. The result is consistent with an earlier finding that homeowners with investments in flood risk reduction are also more likely to have flood insurance than those without investments in flood risk reduction (Kunreuther, 1977). It suggests that certain personality types try to mitigate the impact of possible adverse events by taking advantage of all available means, whereas others do nothing. The results suggest that, irrespective of their level of risk awareness or the price of insurance, some individuals are reluctant to purchase disaster insurance voluntarily since they believe nothing can be done about natural disasters.

4.4 Conclusion

Ignoring events over which one has absolutely no control is perhaps a sensible way to organise one's life. The Stoic philosophers, for instance, espoused that it is foolish to worry about things that are beyond one's control (Epictetus, 1983). Therefore, homeowners who believe natural disasters and their effects are beyond human control may resign themselves to the vagaries of nature and fail to take mitigation measures since what is bound to occur will happen, regardless of their efforts. This study investigates whether the degree to which individuals believe they control their own destiny influences their natural disaster insurance purchasing decisions. The

results suggest that people who think they can influence what happens to them to some extent are more likely to have disaster insurance than those who believe luck, fate, or supernatural forces determine what happens to them. Beyond providing information about natural disasters, governments who seek to boost disaster insurance adoption may also consider ways to influence the public's perception of natural disasters.

Since locus of control orientation is learned and influenced by culture, it stands to reason that individuals in a country where public investment in disaster risk reduction is lacking might be more inclined to view natural disasters as beyond human control. In his study on the morale of disaster survivors, MacCurdy (1943) argues that individuals tend to fear shocks they have never experienced before, but they become progressively less frightened after surviving a series of such events.[11] The previous apprehension then gives way to a misplaced confidence in their ability to withstand future shocks, especially if they see nothing done to prevent future events, but manage to survive. They then assign their survival to fate, becoming fatalistic 'either as a conscious philosophy or merely as an attitude of resignation to the vagaries of fortune that are so unpredictable, so beyond understanding or control, that it is futile to worry about them' (MacCurdy, 1943, p. 13).

MacCurdy's (1943) insight begs the question of whether public investment in disaster risk reduction can influence public attitudes towards natural disasters. The case of the German city of Dresden, which suffered two major floods in August 2002 and July 2013, is an example. Although the severity of the 2013 floods was almost twice that of the August 2002, the impact of the 2013 floods was lower because of public investments in flood risk reduction since the

[11] Kousky, Pratt and Zekhauser (2010) make a similar point. They suggest that when a risk that has never been experienced ('virgin risk') occurs, we tend to overestimate the probability of another occurrence in the future. However, after repeated experiences, we fail to (or barely) update our assessments of the probability of another occurrence, partly because while the first occurrence makes it suddenly salient, subsequent ones do not add much to its availability.

2002 floods (Merz et al., 2014). Could a resident in Dresden be more likely to appreciate the efficacy of preventive measures compared with a resident in Accra who suffers floods almost yearly but sees nothing done to mitigate disaster impacts? Future studies may explore whether and how governments can demonstrate the efficacy of preventive measures by investing in disaster risk reduction and, thereby, influence individuals' perceptions about the human capacity to reduce the risks and impacts of natural disasters.

Furthermore, Thaler and Sunstein (2009) argue that how different options are framed and presented can influence individuals' decisions. Therefore, by framing their messages in a manner that connects with homeowners' moral values, insurers in developing countries could nudge homeowners to adopt disaster insurance. For example, nineteenth-century insurers in the West turned the objection that insurance interfered with the divine plan by arguing that it was failure to exercise prudence which was immoral and that while people must rely on divine providence, they must also 'employ the means by which the Providence of God acts' (The Morality of Life Insurance, 1850, p. 117). Studies are therefore needed as to ways insurance can be presented to make it appeal to the moral and values of homeowners in developing countries. For example, given that most African societies are collectivist and have close commitments to members of the group, could designing and presenting insurance as a kind of a mutual fund, out of which the misfortunes of members met, nudge homeowners to adopt disaster insurance?

Chapter 5 Summarising discussion and conclusion

In the light of the increasing cost of natural catastrophes around the world, many experts suggest insurance as one way to make societies more resilient. By promptly reimbursing victims of natural catastrophes, insurance can help their quick recovery. Moreover, a well-designed insurance scheme can incentivise individuals to reduce their risks in exchange for lower premiums. In most developing countries, however, many individuals are denied the benefits that insurance provides as only a few of them insure against natural disasters. Thus, victims of natural catastrophes tend to depend on disaster aid; however, since disaster aid is (often) provided on an ad hoc basis, victims of catastrophes cannot rely on this kind of compensation. Besides, governments finance disaster aid through (additional) taxes or divert resources from other critical sectors, thus weakening overall economic development. Insurance could serve as a more effective and efficient way of helping the recovery of victims of natural disasters.

Consequently, there are several global initiatives – such as the Access to Insurance Initiative (A2ii) and the G7 InsuResilience – to improve access to disaster insurance in developing countries. Although these initiatives are laudable, there are several examples of countries where disaster insurance is available but there is low demand, suggesting that the issue of lack of access to insurance is only a part of the problem. The aim of this thesis, therefore, was to understand why even when disaster insurance is available in developing countries, only a few homeowners purchase it by examining how the decision process of individuals, insurance companies and government agencies create both demand- and supply-side barriers to disaster insurance adoption. Understanding why many individuals fail to purchase the existing disaster insurance schemes will inform the design of future ones.

To achieve the above aim, the economics, insurance and psychology literature were surveyed to understand the alternative economic and behavioural explanations of the lack of demand for disaster insurance, especially in developing countries. One of the key issues in the literature as

to why only a few individuals purchase disaster insurance is individual cognitive limitations that lead them to misjudge their risks or perceive themselves as less likely to suffer a loss and thus skip insurance adoption. Regarding the question of whether the provision of disaster aid discourages demand for insurance (charity hazard), the available empirical evidence offers little support. However, one of the central issues in the literature, especially in developing countries, is asymmetric information between insurers and policyholders, which may lead to efficiency loss under adverse selection. The absence of historical data on natural catastrophes and lack of knowledge regarding hazard-prone areas may influence insurers in developing countries to excessively 'load' the pure premium, thus making the premium too high and unattractive to potential policyholders.

In mature insurance markets, insurers have invested in advanced risk assessment technologies which allow for easy access to hazard information. German insurers, for instance, have developed an online database – ZÜRS Geo Zoning System – which shows the risk of flooding for every address in the country. Hence, adverse selection may not be a major issue in such markets; insurers may even have superior information than policyholders with respect to natural catastrophes. To further explore the lack of data on natural hazards in developing countries, the thesis examined how it affects the pricing decisions of Ghanaian insurers. Particularly, the thesis investigated how Ghanaian insurers react to homeowners who invest in flood risk reduction. In a market where insurers are well informed about risks at the micro level, insurers incentivise further investments in risk reduction by reducing the premia for individuals who undertake preventive measures. The thesis found, however, that Ghanaian insurers did not reward homeowners who invest in flood risk reduction; rather, they charged those with investments in risk reduction higher premium, suggesting that the insurers interpreted the investments in precautionary measures as a sign of high risks. Such actions by insurers can discourage homeowners from investing in risk reduction as they do would not want to portray themselves

as high risks. Moreover, those who invest in risk reduction may consider insurance as poor value for money since the premium does not reflect their low-risk type.

The thesis also looked at demand-side barriers relating to decision processes of individuals that prevent them from purchasing disaster insurance even when insurance coverage is available at actuarially-fair premiums. Primarily, the thesis examined how societal mores may influence individuals' insurance purchasing decisions and found homeowners who believe they control their own destiny more likely to purchase disaster insurance, compared with those who believe that luck, fate or external forces control what happens to them. This highlights the importance of worldviews in individual insurance purchasing decisions.

Taking all together, the findings of the thesis suggest that to boost insurance adoption in developing countries and for insurance to enhance the resilience of societies to natural catastrophes, it needs to form part of an overall disaster risk management strategy. Without a comprehensive risk assessment (involving identifying hazards, assembling data, mapping vulnerable areas, land-use planning and estimating potential loss), private insurers may consider natural disaster risks as 'uninsurable' or will only provide coverage inefficiently. Governments in developing countries may have to consider the gathering and provision of data on extreme natural event risk as a public good: Higher risk awareness may deter prospective dwellers from living in known hazard-prone areas as well as enable insurers to reward investments in risk reduction measures. This is an area that global initiatives on disaster insurance in developing countries can make an impact. Assisting developing countries financially and technically to gather, store and share data on natural hazards can help to overcome market barriers.

In Ghana, for example, there is neither publicly available hazard maps nor database on natural disasters. Even at the international level, there are only three cross-country, multiple-hazard databases on natural disasters: The Centre for Research on the Epidemiology of Disasters'

(CRED's) Emergency Events Database (EM-DAT), Swiss Re's Sigma, and Munich Re's NatCatSERVICE. Unfortunately, the databases of Swiss Re and Munich Re are not publicly available and although the EM-DAT database is publicly available, it has many challenges. A disaster must fit at least one of the following criteria before it can be included in the database: 10 or more people killed, 100 or more people affected, declaration of a state of emergency, and call for international assistance. The effect is that many frequent but lower impact disasters may not be captured although their sum could be substantial. Moreover, only the top-ten disasters are included in the database, implying that if a country has suffered 100 disasters all of which meet the criteria for inclusion, only the top-ten in terms of economic damage will be featured.

The provision of data on natural hazards must go together with public investment in disaster risk reduction, enforcement of building codes and strict land use planning because, without that, well-informed insurers may withdraw coverage for areas they consider too risky. Besides, public investment in disaster risk reduction may demonstrate the efficacy of preventive measures to the residents and help influence their perception about natural catastrophes. Where victims of natural disasters see that nothing is done to prevent future ones, they may conclude that nothing can be done about it and consciously or unconsciously attribute their survival to fate, seeing no need to take personal responsibility for hazard response such as insurance adoption.

Finally, *nudge* theory suggests that how insurance is framed and presented can influence its adoption. Could framing disaster insurance in a manner that connects with homeowners' moral and cultural values nudge them to adopt disaster insurance? For example, nineteenth-century insurers in the West turned the objection that insurance interfered with the divine plan by arguing that it was the failure to exercise prudence which was immoral. Studies are therefore needed as to ways insurance can be presented to make it appeal to the moral and cultural values of homeowners in developing countries.

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Appendix A: Survey questionnaire

A survey on disaster insurance adoption among homeowners in Accra.

My name is Benjamin Addai Antwi-Boasiako from the Dresden Leibniz Graduate School of the Technische Universität Dresden, Germany. I am conducting a research on the perception of homeowners about natural disaster insurance adoption in fulfilment of the requirements for my Ph.D. dissertation, under the supervision of Prof. Dr. Dr. Bernhard Müller and Prof. Dr. Marcel Thum.

If you decide to take part in this survey, you will answer questions about whether you have insured your home against natural disasters and what influenced your decision. This survey will take about 20 minutes to complete.

You have been asked to take part in this study because you own a house in Accra. However, your participation is voluntary and you may stop at any time.

There are no risks for taking part in this study. In order that nobody can find your name and answers, we are asking you to fill out the survey anonymously. We will not collect your name or any other identifying information on the survey. We will also report information about groups of people, not individual answers, so it will not be possible for readers to know who said what.

You will not gain anything directly by taking part in this study. However, if you participate, you may be helping us understand why some homeowners decide to buy insurance while others do not.

If you have any questions about this study, please contact Benjamin Addai Antwi-Boasiako at b.antwi-boasiako@dlgs.ioer.de (Ghana number: 0263426794), or his supervisors Prof. Dr. Dr. Bernhard Müller (b.mueller@ioer.de) and Prof. Dr. Marcel Thum (marcel.thum@tu-dresden.de)

Thank you for agreeing to participate.

Q.1. Please read each statement. Where there is a blank, decide what your normal or usual attitude, feeling, or behaviour would be. (Of course, there are always unusual situations in which this would not be the case, but think of what you would do or feel in most normal situations.)

	(A) Rarely	(B) Occasionally	(C) Sometimes	(D) Frequently	(E) Usually
When faced with a problem I ... try to forget it.	☐	☐	☐	☐	☐
I ... need frequent encouragement from others for me to keep working at a difficult task.	☐	☐	☐	☐	☐
I ... like jobs where I can make decisions and be responsible for my own work.	☐	☐	☐	☐	☐
I ... change my opinion when someone I admire disagrees with me.	☐	☐	☐	☐	☐
If I want something I ... work hard to get it.	☐	☐	☐	☐	☐
I ... prefer to learn the facts about something from someone else rather than have to dig them out for myself.	☐	☐	☐	☐	☐
I ... will accept jobs that require me to supervise others.	☐	☐	☐	☐	☐
I ... have a hard time saying "no" when someone tries to sell me something I don’t want.	☐	☐	☐	☐	☐
I ... like to have a say in any decisions made by any group I'm in.	☐	☐	☐	☐	☐
I ... consider the different sides of an issue before making any decisions.	☐	☐	☐	☐	☐
What other people think ... has a great influence on my behaviour.	☐	☐	☐	☐	☐
Whenever something good happens to me I ... feel it is because I've earned it.	☐	☐	☐	☐	☐
I ... enjoy being in a position of leadership.	☐	☐	☐	☐	☐
I ... need someone else to praise my work before I am satisfied with what I've done.	☐	☐	☐	☐	☐

	(A) Rarely	(B) Occasionally	(C) Sometimes	(D) Frequently	(E) Usually
I am ... sure enough of my opinions to try and influence others.	☐	☐	☐	☐	☐
When something is going to affect me I ... learn as much about it as I can.	☐	☐	☐	☐	☐
I ... decide to do things on the spur of the moment.	☐	☐	☐	☐	☐
For me, knowing I've done something well is ... more important than being praised by someone else.	☐	☐	☐	☐	☐
I ... let other peoples ' demands keep me from doing things I want to do.	☐	☐	☐	☐	☐
I ... stick to my opinions when someone disagrees with me.	☐	☐	☐	☐	☐
I ... do what I feel like doing not what other people think I ought to do.	☐	☐	☐	☐	☐
I ... get discouraged when doing something that takes a long time to achieve results.	☐	☐	☐	☐	☐
When part of a group I ... prefer to let other people make all the decisions.	☐	☐	☐	☐	☐
When I have a problem I ... follow the advice of friends or relatives.	☐	☐	☐	☐	☐
I ... enjoy trying to do difficult tasks more than I enjoy trying to do easy tasks.	☐	☐	☐	☐	☐
I ... prefer situations where I can depend on someone else’s ability rather than just my own.	☐	☐	☐	☐	☐
Having someone important tell me I did a good job is ... more important to me than feeling I've done a good job.	☐	☐	☐	☐	☐
When I'm involved in something I ...try to find out all I can about what is going on even when someone else is in charge.	☐	☐	☐	☐	☐

Q.2. How much will cost to rebuild a building similar to yours (excluding the cost of the land)?

- [ ] Less than GHC100,000
- [ ] Between GHC100,000 and GHC200,000
- [ ] Between GHC200,000 and GHC500,000
- [ ] Between GHC500,000 and GHC1,000,000
- [ ] More than GHC1,000,000

Q.3. For how long have you lived in your present home?

- [ ] Less than 7 years
- [ ] Between 8 and 15 years
- [ ] Between 16 and 24 years
- [ ] 25 years or more

Q.4. What is the highest level of school you have completed?

- [ ] No schooling completed
- [ ] Primary School
- [ ] JSS/JHS/Middle School
- [ ] SSS/SHS/O-Level/A-Level
- [ ] Post-secondary education

Q.5. How likely do you think it is that your own home will be seriously damaged by, earthquake, flood, storm, etc. in the next ten years?

- [ ] Very likely
- [ ] Somewhat likely
- [ ] Somewhat unlikely
- [ ] Not very likely

Q.6. Do you personally know anyone whose house has been damaged by flood, storm, fire, in the last five years?

- [ ] Yes
- [ ] No

Q.7. Within the past five years, have you experienced a loss to your house caused by flood, earthquake, storms, etc.?

- [ ] Yes
- [ ] No

Q.8. Do you currently have insurance for the house?

- [ ] Yes
- [ ] No

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1. Hiermit versichere ich, dass ich die vorliegende Arbeit ohne unzulässige Hilfe Dritter und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe; die aus fremden Quellen direkt oder indirekt übernommenen Gedanken sind als solche kenntlich gemacht.
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5. Sofern es sich um eine kumulative Dissertation gemäß § 10 Abs. 2 handelt, versichere ich die Einhaltung der dort genannten Bedingungen.
6. Ich bestätige, dass ich die Promotionsordnung der Fakultät Umweltwissenschaften der Technischen Universität Dresden anerkenne.

Dresden, den 20.01.2017

Benjamin Addai Antwi-Boasiako